THURSDAY, DECEMBER 23, 1886

CANAL AND RIVER ENGINEERING

The Principles and Practice of Canal and River Engineering. By David Stevenson. Revised by his Sons, D. A. and C. A. Stevenson. Third Edition. Pp. xiv. + 406, and 18 Plates. (Edinburgh: A. and C. Black, 1886.)

THE fact of this work having reached a third edition shows its appreciation by the public. The title, however, indicates a wider scope than that actually embraced. Thus only 65 pages are given to canals, and these only for navigation; no mention is made of the very large subject of irrigation-canals (surely a passing notice of the reason of this omission was required). In this short compass (30 pages given to barge canals, 35 pages to ship canals), part of which is an historical sketch, it is of course impossible to give much constructive detail. Thus no details or sketches are given of most of the appliances needed for canals, *e.g.* locks, turbines, lifts, waste-weirs, &c. The two chapters on canals are otherwise unsatisfactory; *e.g.* 14 pages devoted to the Suez Canal consist chiefly of extracts from Reports made in 1863 and 1870: much of this now purely historical matter might have been with advantage replaced by later information.

The remainder of the work (331 pp.) is devoted to river improvement. And this part of the work is of great value and interest, especially where accounts are given of some of the numerous successful instances of improvements of estuaries effected by the author and the revisers themselves. The great help of a large rise and fall of tide to a commercial port situate in the tidal portion of a river, viz. in aiding vessels coming to and leaving the port, is first explained; the pre-eminent importance of this tidal action to England is evident. As might be expected, then, the greater part of the work is devoted to the improvement of the tidal portion of rivers such as those of the British Isles.

Two useful chapters (92 pp.) are given to the observations required for a project for such work, *e.g.* tidal phenomena, soundings, current-velocities, discharges, salinity, &c. In quoting Cunningham's instrument (twin balls, sunk one to ·211 and one to ·789 of the depth) for measuring mean velocity past a vertical *at one operation*, it should be stated that the two balls should be *alike in all respects*. Fourteen pages are given to the subject of "under-currents"; one instance is quoted (p. 135) of a velocity of 4 miles per hour at 50 feet depth measured with a "double-float," when the surface-velocity was only 1·8 miles per hour. This is one of the best instances (known to the reviewer) of the excellence of the "double-float" (when well designed) for sub-surface velocity-measurement; several other good instances are quoted. These should surely convince those who condemn the "double-float" as useless for such work. The natural defects of most (tidal) rivers in their tidal reaches are detailed as the presence of a "bar" at the mouth, of hard veins of gravel, rock, &c., obstructing the water-way, of extensive mud or sand flats through which the deep channel is ever shifting, &c.

The explanation of the cause of a "bar" at a river mouth now generally accepted, viz. as being really a submerged part of the "beach" of the outer shore-line, produced from the sea by the action of the waves (not from the alluvium brought down by the river), appears to have been first proposed by the author of this work in 1842. This suggests the treatment usually found successful in tidal rivers, viz. prolonging the fairway of the river, by piers, seawards into the deep water beyond the reach of the waves which produce the beach. And it is seen that this will fail in effecting a permanent cure in deltaic rivers, in which the gradual advance of the delta will reproduce shoal-water outside the ever-advancing mouths, in which the waves will therefore reproduce a bar.

The ideal improvement to be aimed at in the tidal part of a river is explained to consist chiefly in introducing increased tidal scour by removing obstruction to it (such as bars, &c.), and by confining its action under half-tide to a definite channel. These changes accelerate the propagation of the tidal wave, and decrease the tidal current, thereby giving (sometimes greatly) increased depth of water, not only over the bar at the mouth, but throughout the tidal reaches, and also prolong the duration of the tidal effect. The benefit of these results to navigation is obviously very great.

It is shown that jetties, groynes, &c., projected from the banks of a stream for confining the fairway to a defined channel are very uncertain in their effects. The course recommended in general is the use of low parallel training walls for confining the course of the river under half-tide to a single definite channel, low enough to be covered at half tide. Several interesting instances are given of the failure of the jetties, &c., and success of the low parallel wall system. After this treatment silting will generally occur in places behind the training walls, increasing gradually till marsh-land is produced; after which it is often possible to reclaim some of the raised land: but it is stated that it seldom pays to do this in British rivers until the silting has raised the land to the level of ordinary spring-tides. A most useful practical rule is proposed, that reclamation work should only be undertaken as part of a large general scheme of improvement of a navigation, and never be permitted to the desultory self-interested efforts of private riparian proprietors.

A short chapter (9 pp.) is given to the effect of bridge on navigable rivers. In highly civilised countries this is now a question of rapidly increasing importance. It is shown that the interests of the bridge constructors, especially in the case of railways, are generally adverse to those of the navigation. Of course the subject cannot be much developed within 9 pages. But a short description (with plate) of the railway swing-bridge over the Ouse has been included.

An excellent account is given (31 pp.) of the various processes of dredging and excavating, with a description of some of the most recent machines, and an analysis of the cost of the work.

It will be seen that on the whole this treatise is an excellent account of the principles and practice of river engineering, to the successful practice of which its able authors have so largely contributed.

ALLAN CUNNINGHAM, Major R.E.

ALPINE WINTER

Alpine Winter in its Medical Aspects: with Notes on Davos Platz, Wiesen, St. Moritz, and the Maloia. By A. Tucker Wise, M.D., &c. Third Edition. (London: Churchill, 1886.)

THIS work possesses a fourfold interest. The meteorologist will find in it an account of the Swiss Alpine climate in winter, with full and careful records of the author's observations, which occupy one-fourth of the whole volume. The sanitary engineer may here obtain a clear account of the first successful attempt that has been made to warm and ventilate a large building on strictly scientific principles during the months when the temperature of the air frequently falls below zero. To the physician the book will serve as a guide in advising his patients on the subject of the Alpine health-resorts, in the determination of suitable cases, the peculiar advantages of each place, the duration of stay, and the time to leave—giving, as it does, the physiological effect of each of the peculiar elements of a winter climate at high elevations. Lastly, all those who, either from necessity or from choice, have arranged to pass part of the winter in the Engadine or at Davos, can learn from these pages how to plan and prepare for their outfit and journey, the best routes by which to travel, how to avail themselves of the advantages of the winter health-resorts of these parts, and how to minimise the drawbacks or dangers connected with this system of treatment.

The principal places which Dr. Tucker Wise describes are Davos-am-Platz, Wiesen (a warm bright hamlet six miles lower down the stream), St. Moritz (now almost as renowned for the winter effect of its atmosphere in consumption as of its waters in debility), and, lastly, the Maloia. As the author has now taken up his residence at the Maloia *Kursaal*, it is only natural that he should devote a considerable part of his book to it. It is this hotel which presents, as we have said, the earliest and one of the greatest efforts in the direction of artificial heating and ventilation in the Alps. Nature and art meet at the Maloia in the most interesting combinations. Without the *Kursaal* there is the brilliant, dry, calm, absolutely pure atmosphere of the Upper Engadine, "laden with balsamic vapour from the pines"; within its walls there is every appliance which science can suggest to preserve the purity and maintain the proper temperature of the respired air, constantly liable as it is to dangerous contamination by the residents, who to the number of several hundreds can be accommodated in its apartments. The elaborate system adopted for warming and circulating the admitted air is fully explained in this work with the aid of a series of large diagrams. The air, drawn from the outside on the basement, is made to pass over a series of *batteries*, consisting of steam-pipes inclosed in a case, by means of which it is raised to a temperature of 50° C., whilst it is at the same time mixed with a due proportion of watery vapour. The ascending power of the heated air raises it to the rooms above, which it enters at a rate sufficient to change the atmosphere every two or three hours. To extract the used-up air there are two tubes of exit, which finally communicate with an iron casing around the main flue of the furnaces, which thus acts as the extraction-shaft. Not only is every room thus warmed and ventilated, but the atmosphere of any particular chamber can be medicated at will by placing an antiseptic agent in the air-tube supplying it. A plan has also been adopted in the *Kursaal* of introducing ozone into the building by means of the electricity used for lighting, the motor force for the machines being a fall on the River Inn. "The ozoniser draws off its electricity from the main current of the incandescent lights. After passing through an inductorium, an induced current of about 200,000 volts is obtained, and distributed over the surface of numerous glass plates coated with tin-foil. The method employed is an imitation of the natural process which takes place in the atmosphere,—the production of ozonised air by electricity in a state of high tension. Air is forced between the glass plates and through the ozoniser by means of a 'blower,' driven by a water motor."

To those for whom any of the subjects which we have selected for comment may possess practical interest we would say: "Do not be satisfied with reading Dr. Tucker Wise's book; go and see for yourselves on the spot." There is no more enjoyable or more successful holiday in our dark and dreary winter for the jaded dweller in large English towns than a few weeks spent in the sparkling air of St. Moritz or the Maloia. B.

OUR BOOK SHELF

Magnetic Horizontal Intensity in Northern Siberia. By A. C. von Tillo. From the *Repertorium für Meteorologie*, Band x., No. 7. (St. Petersburg, 1886.)

THE maps of lines of equal magnetic horizontal intensity which have been published during recent years have been more or less defective in that part of Siberia lying north of the 60th parallel of latitude, partly arising from want of fresh observations, but more directly from insufficiency of data respecting the secular change of that element.

The present paper, with its accompanying map, is intended to remedy these defects, as far as is at present possible, for the epoch 1880. For this purpose, every observation since 1828, when Hansteen and Due started on their well-known magnetic survey, has been collected in a Table A, and the best values obtainable of the secular change in a Table B. As represented in the latter table, the secular change is of so moderate an amount, that every observation during the interval 1828–84 may, without large error, be considered available for combination in one map for 1880.

This has been accordingly done, and a map drawn, showing lines of equal horizontal intensity expressed in Gaussian units, the scale being in conformity with that of the maps published in the *Annalen der Hydrographie*, Heft vii., July 1880.

Amongst the most important recent observations recorded in Table A are those of F. Müller in the *Olenek* Expedition of 1873, and of the voyage of the *Vega* in 1878–80, and as a whole the paper and map may be taken as a valuable contribution to terrestrial magnetism. The secular change, however, still remains a quantity requiring much more accurate results than those hitherto obtained for Siberia, and such as are derived from prolonged observation in one spot, it being now well known that a change of position of a few feet often allows an element of error to enter, caused by local magnetic disturbance.

The Ordnance Survey of the United Kingdom. By Lieut.-Colonel T. Pilkington White, R.E. (London and Edinburgh: Blackwood and Sons, 1886.)

THIS is a slight sketch, most of which has already appeared in *Blackwood*. Carefully as the author has kept himself

to what in an account of many businesses would be "dry detail," avoiding all anecdote, either biographical or operative, in illustration of work done, it is still a most interesting little book to all who have seen the Ordnance surveyors and their assistants about the town or country, or even their mark upon the stone, brick, or other permanent material. Few indeed will there be who will not find their own special taste ministered to either in the account of the measurement of a base-line with its verification by astronomical observation, by trigonometrical calculation, and by exact chain measurement of a known proportion of it, with the record of frequent triumphs of marvellous correctness; or, again, in the exactness required and gained in the standard measure, with the careful comparison of the English measure with the corresponding foreign standards by which to unite our observed measurements with those of other countries. Such histories give confidence in the trustworthiness of the maps when published, to the surveyor, and hence to both buyer and seller of land. Distant, we hope, is the time when they will be of value to military commanders for choosing ground and availing themselves of the various features of the country, so well laid down that a practised eye like that of Prof. J. Geikie can detect different geological formations by the shading of the hills! Still, this military value is an argument for the frequent revision of maps in which even trees are marked down that would form an important item in strategical movements. We must sympathise in the hope strongly expressed here that the present accomplished staff may be permanently kept together in periodical revision of these maps. Their value after a space of time to the scientific geologist wishing to compute rates of denudation or deposition is invaluable; while a much more potent argument to this generation probably is that much of the whole surface of Lancashire and Yorkshire has been changed by the hand of man during the forty years which have now elapsed since that district was surveyed, and perhaps the environs of London still more completely during the twelve to twenty-one years since the maps of them were published. Certainly no one who reads the numerous labours to which they have turned their hands, some of them seeming little connected with their regular work, can have any fear of idleness on the part of the staff of this department.

LETTERS TO THE EDITOR

[*The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.*

[*The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.*]

The Cambridge Cholera Fungus

In No. 247, vol. xli. of the *Proceedings* of the Royal Society, just published, there is a preliminary report on the pathology of cholera asiatica, by Messrs. C. Roy, J. Graham Brown, and C. S. Sherrington, in which these gentlemen describe and figure the occurrence, in the tissue of the intestinal mucous membrane of persons dead of cholera asiatica, of hyphæ or mycelial threads and "granules." Messrs. Vines and Gardiner have, we are told, declared these to be Chitridiaciæ. We are further informed that these Chitridiaciæ were found by Messrs. Roy, Brown, and Sherrington in the intestinal mucous membrane of the twenty-five cases of cholera they have examined, as also in the kidney, and in the blood-vessels of some of these cases.

I have no hesitation in saying that I consider these statements are based on error. What these gentlemen have seen and described is nothing less or more than the hyphæ or mycelial threads of common mould (probably aspergillus), which, during preserving of the material, have grown from the free surface into the tissues. I possess a large number of specimens made of the diseased intestine, lung, kidney, liver, and skin of various animals and men, in no way connected with cholera asiatica; in many of them I find the exact appearances described and figured by these gentlemen, viz. mycelial threads of precisely the same size and appearance as those above mentioned. They are seen to penetrate from the surface, where they form a copious dense mycelium, into the depth to various degrees. I possess sections through the mucous membrane of the intestine of the calf, of the mouse, of the guinea-pig, and of man, in which these hyphæ have penetrated as deep as the submucous tissue; in the lymphatics of this part they were very abundant. Similarly, I have specimens of the lung of calf, cow, and guinea-pig, where the growth of the mycelial threads can be traced from the pleural surface into the lung-tissue; in the lymph-vessels of the intertubular septa they are very numerous, and possessed of those knob-shaped outgrowths figured and described by Messrs. Roy, Brown, and Sherrington. I have also specimens of the ulcerated skin of calf and cow, where these hyphæ can be traced as deep as the subcutaneous tissue. Into the kidney and the mesenteric lymph-glands they also penetrate, but less than in the above organs, probably owing to the greater density of the tissue.

Now, in all these instances, these tissues had been preserved during and over the summer months; they were examined after three or more months' preservation, and the sections were stained in methylene-blue. But I must state, also, that the same tissues had been examined fresh, and after a few weeks' hardening, and in none of them had any mycelial growth been present. It is a fact, as is pointed out by Roy, Brown, and Sherrington, that methylene-blue brings the threads out more easily and better than other aniline dyes.

There can be absolutely no doubt about the identity of the Cambridge "Chitridiaceæ" with the hyphæ of the common mould found in the sections of my non-choleraic specimens. What Messrs. Roy, Brown, and Sherrington describe as "granules," connected by delicate filaments, are, in most instances, filaments and branches seen in optical or real transverse section; with careful fine adjustment of the microscope this can be without difficulty ascertained.

Messrs. Roy, Brown, and Sherrington assume that their Chitridiaceæ have been overlooked by others who have examined cholera intestines, because methylene-blue had not been used. This assumption is entirely wrong, because methylene-blue, as Löffler's (or alkaline) solution and in other modifications, had been used by many investigators. While in India, I largely used it for the staining of sections, fresh, and after a few days' to a few weeks' hardening, and I know, as a positive fact, that the German Commission have, in Egypt, in India, and after their return to Berlin, largely used this dye. But in not one single case have they or have I found anything of mycelial threads either in the intestinal mucous membrane or in any other organ. The only difference between Messrs. Roy, Brown, and Sherrington on the one hand, and all other investigators on the other, is this, that while the former kept their material bottled for some months (*vide* their report, p. 177), the latter examined theirs fresh or after short and careful hardening. That this is the real explanation of the difference of our results is proved by the following:—A bottle containing bits of choleraic intestine preserved by me in Calcutta, and brought over to England, was opened many months after; sections were made of the intestine, and stained in methylene-blue. On the free surface of the mucous membrane was found a dense plexus of mycelial threads of common mould, from which threads of various thickness had singly grown into the tissue to the depth of the submucous tissue.

Of the same choleraic intestine numerous sections had been made in Calcutta, fresh, and after a few weeks' hardening; these had been stained in methylene-blue, but in none of them is there any trace of mycelial threads. I have these sections at present in my possession; and, while they show that there is a complete absence in the mucous membrane of mycelial threads, the others, viz. those made of the same intestine, and after the same method, but after having been kept bottled for some months, show beautiful mycelial threads pervading the mucous membrane through all depths.

These threads, in their course, thickness, mode of branching, in the character of the bud-like sprouts, in short in all their

morphological characters, are unmistakably identical with the hyphæ found in specimens of the non-choleraic intestine, lung, skin, kidney, mesenteric glands, preserved, as stated above, over the summer.

In conclusion I wish to say that I shall be most happy to place at the disposal of Messrs. Roy, Brown, and Sherrington, as also of Messrs. Vines and Gardiner, the materials or sections, mounted and stained, of the various non-choleraic tissues in which are present the mycelial threads of common mould identical with the Cambridge cholera fungus. E. KLEIN

94, Philbeach Gardens, Earl's Court, December 18

The Longitude of Rio

MAY I ask for a few lines in which to correct an erroneous impression naturally made by a sentence in my recent paper on "Ten Years' Progress in Astronomy," which you have honoured me by reprinting in NATURE. The sentence relates to the longitude of Rio; and although it does not really assert that the error in this longitude was first detected and corrected by our American naval officers, yet I must frankly admit that the connection and form of expression are such that this would be the natural, though incorrect, inference. The fact is that Admiral Mouchez and his coadjutors in the French Navy had already, by their chronometric and other work, brought the uncertainty to very narrow limits (say ± 2s.) before the telegraphic campaign of the Americans. The history of the case is peculiar, but too long to be given here: it affords an excellent example of the uncertainty of longitudes based on lunar observations.

The misleading form of the sentence is due to a little carelessness on my part in cutting down the much more extended statement I had made in the first draft of the paper. The available limits of time and space compelled me to compress my material to the utmost.

I cheerfully make this correction in justice to Admiral Mouchez, who has called my attention to the matter.

Princeton, N.J., December 9 C. A. YOUNG

An Error in Maxwell's "Electricity and Magnetism"

MANY of your readers will be aware that Maxwell (ii. § 544) deduces the equations of induction of currents from the laws of electro-dynamics with the aid of the principle of energy, using a proof taken from Helmholtz. I find that this proof is erroneous; and, as a point of considerable physical interest is involved, I wish to call attention to the error in your columns.

We suppose two circuits carrying currents to be moving relatively to each other. Let R_1, R_2 be the resistances, I_1, I_2 the currents, A_1, A_2 the electromotive forces of the batteries, and $-I_1 I_2 \frac{dV}{dt}$ the rate at which work is done by the external forces which are moving the circuits. Then $A_1 I_1 + A_2 I_2$ is the rate at which the batteries are doing work, and $R_1 I_1^2 + R_2 I_2^2$ is the rate at which energy is being changed into heat in the wires. So Maxwell says we have—

$$A_1 I_1 + A_2 I_2 - I_1 I_2 \frac{dV}{dt} = R_1 I_1^2 + R_2 I_2^2 \quad . \quad . \quad (1)$$

and it is this equation that is wrong. He has omitted to take into account the change in the electro-kinetic energy which is taking place. If, for instance, the two batteries were suddenly thrown out of the circuits, the quantity of heat that would afterwards appear, either in the wires or in the form of sparks, would depend on the relative position of the circuits. And the energy that would then appear as heat previously exists in the form of electro-kinetic energy.

Let M be the coefficient of mutual induction. Then, if we neglect the rate of change of the currents, the rate of increase of the electro-kinetic energy is $I_1 I_2 \frac{dM}{dt}$. So, instead of (1), we should write—

$$A_1 I_1 + A_2 I_2 - I_1 I_2 \frac{dV}{dt} = R_1 I_1^2 + R_2 I_2^2 + I_1 I_2 \frac{dM}{dt} \quad . \quad (2)$$

If we assume the accepted equations of induction of currents, viz.—

$$\left.\begin{aligned} A_1 &= R_1 I_1 + I_2 \frac{dM}{dt} \\ A_2 &= R_2 I_2 + I_1 \frac{dM}{dt} \end{aligned}\right\} \quad . \quad . \quad . \quad . \quad (3)$$

neglecting, as before, the rate of change of the currents, we see that $\frac{dM}{dt} = -\frac{dV}{dt}$.

And therefore the decrease of electro-kinetic energy is equal to the work done by outside mechanical forces on the system. This result was long ago obtained by Sir William Thomson, as is indeed noticed by Maxwell in this very article.

Notwithstanding the use of the incorrect equation (1), Maxwell obtains a correct result. In fact, he falls into a second error which exactly compensates for the first. He supposes I_2 to be very small compared with I_1, and says that we may then with sufficient accuracy put $A_1 = R_1 I_1$ in (1). But by (3) we see that the term thus neglected is $I_1 I_2 \frac{dM}{dt}$, which is not negligible.

As I have not had access to Helmholtz' original memoir, I cannot say whether Maxwell has correctly transcribed his proof.

JAMES C. MCCONNEL

St. Moritz, Engadine, Switzerland

Seismometry

IN reply to my letter answering Prof. Milne's assertions (NATURE, Nov. 25, p. 75), Mr. T. Gray (his associate in seismometric work) says nothing in support of these, but attacks me on two distinct and quite irrelevant issues. The tone of Mr. Gray's letter (Dec. 9, p. 126) is unusual: as to that no answer is necessary; but the two questions of fact raised by him require reply.

(1) Mr. Gray writes:—"He [Prof. Ewing] says, or leads one to infer, that he introduced horizontal pendulums in seismology." On the contrary, what I *have* said (in my memoir on "Earthquake Measurement," Tokio, 1883, p. 21) is this:—

"It appears that the earliest attempt to apply the horizontal pendulum to the measurement of earthquake-motions was made by Prof. W. S. Chaplin, of the University of Tokio, about 1878. His apparatus consisted of a wooden rod, free to turn about a vertical axis, and carrying at its end a rigidly attached block. It was intended that the motion of the earth should be recorded by a tracing-point fixed to the block, writing on a smooth surface fixed to the earth below it. There was no multiplication of the motion, and either for this reason, or because friction was not sufficiently avoided at the joints and pointer, no results were ever obtained, and the apparatus was abandoned."

The passage Mr. Gray alludes to as having been "read in my presence" was a casual reference by Prof. Milne to these unsuccessful experiments. Prof. Chaplin, their author, has himself written to me:—

"I certainly think you were the first to use successfully a seismograph depending on the principle of the horizontal pendulum. I believe the records obtained by you with this seismograph were the first obtained in Japan (and probably in the world) which showed the motion of the earth during an earthquake from beginning to end of the shock. I cannot better mark the effect which the first record produced than by relating my own experience. I was, up to that time, working on an instrument for determining the velocity and direction of an earthquake; and my design was founded on the idea that an earthquake began with a sudden and violent *shock*. Your records showed (I believe for the first time) that an earthquake often began with an almost imperceptible motion, which increased in amplitude and might have many maxima; hence my machine would have been useless had I completed it."

What I do claim in this matter is that I succeeded in constructing the earliest successful seismograph capable of making absolute measurements of the horizontal motion throughout an earthquake, in conjunction with the time, and giving records from which the amount, direction, velocity, and acceleration of the successive movements could be, and *were*, for the first time determined. The earliest records, referred to by Prof. Chaplin, were obtained in November 1880, and are described in the *Transactions* of the Asiatic Society o

Japan for that year (vol. ix. p. 40). Further, in publishing an account of the horizontal pendulum seismograph, I pointed out that the way to get a steady-point with respect to one component of earthquake-motion, is to pivot a body in nearly neutral equilibrium, with the corresponding kind of freedom, and to use the centre of percussion as the steady-point, the steadiness of the steady-point being increased, if need be, by pivoting a second mass there. So far as I am aware, this obvious principle was first explicitly recognised and applied in my horizontal pendulum seismograph; and on this point I shall appeal from Mr. Gray of 1886 to Mr. Gray of 1881 :—

"I believe the first time special attention was paid to the application of this well-known dynamical principle to seismometers is to be found in a paper communicated by Prof. Ewing to the last meeting of this Society" (T. Gray, *Trans. Seis. Soc. Jap.*, vol. iii. p. 5).

(2) Mr. Gray's second charge is that I am using his vertical motion seismometer without acknowledgment. I am not using his instrument; and I have acknowledged fully his service to seismometry in this connection. A horizontal bar, loaded at one end and held up by a spring, was used for vertical motion by the British Association Committee at Comrie in 1842. In 1881, Mr. Gray, holding the bar up by a long spiral spring, made the suspension astatic by adding a trough or tube containing mercury (*Trans. Seis. Soc. Jap.*, vol. iii. p. 137). After seeing this, I devised another and simpler method of making the suspension astatic, and in describing it I said :—

"At a recent meeting of the Society, Mr. T. Gray described a seismometer for vertical motion, in which the problem of supporting a heavy mass, so that it should be free to move vertically and yet remain in neutral equilibrium, was for the first time (so far as I am aware) successfully solved" (*Ibid.* p. 140).

My method is entirely different from Mr. Gray's. He now says that it was anticipated by a paper of his, dated May 1880. He did not suggest this at the time; and, on reading the paper now, I can find no trace of the alleged anticipation. In the passage quoted above, and in other writings ("Earthquake Measurement," p 48; NATURE, vol. xxx. p. 152; "Encyclopædia Britannica," Art. "Seismometer"), I have tried to do justice to Mr. Gray's priority in the solution of this problem of vertical astatic suspension; but I prefer, and use, my own later solution.

J. A. EWING

University College, Dundee, December 11

How to make Colourless Specimens of Plants to be preserved in Alcohol

IN your last number (p. 149) Prof. H. de Vries described a valuable method for making botanical museum specimens colourless; but, as it is more important in many cases to keep the original colour, you will allow me to call your attention to a note in the *Berichte der deutschen botanischen Gesellschaft* (1886, No. 8), where Dr. Tschirch describes a method for retaining the colour (green or other) on specimens preserved in spirit. He discovered some time ago that tannates and colouring-matters (as found in plants), with the exception of xanthophyll, form compounds with lead and barium which are insoluble in alcohol, and he based his method on this discovery. He recommends the specimens to be put into solutions of compounds of lead or barium before transferring them to spirit, or simply to add concentrated solutions of acetate or nitrate of lead, or chloride or hydrated oxide of barium, to the spirit. I may add that I have tried this method, but I have not yet got quite satisfactory results. My best results were obtained by plunging the specimens first of all into boiling water before putting them into the above-mentioned mineral solutions.

SELMAR SCHÖNLAND

Botanic Garden, Oxford, December 18

The Recent Weather

MY barometer, at 250 feet above sea-level, fell to 28·20 at 5 a.m. on December 8, and to 27·82 at 8 p.m.

Birstal Hill, Leicester, December 18 F. T. MOTT

I GATHER from your notice of the great storm on the 8th that readings of the barometer taken during its passage across the country will be of some interest. I therefore place at your disposal copies of the records made at Belvoir Castle. An indication of an approaching storm was given by a falling barometer on the 6th, its reading at 9 a.m. on that day being 29·380. The depression increased on the 7th, reaching 28·960; at 9 a.m. on the 8th it had fallen to 28·200, and then went down rapidly, until at 9 p.m. it reached its lowest point, 27·800, the lowest I have registered at this place during a period of thirty-two years. During the 8th the wind was strong from the south, amounting to a gale, and was accompanied with rain, 0·60 being recorded, but it was less violent than the indications of the barometer led me to expect. That the pressure was less intense here than in the storm on October 14, 1881, was evidenced by the escape of timber-trees; some 400 to 500 were blown down in 1881, and not half a dozen in the woods adjacent to the Castle on the 8th. Belvoir Castle is in the northern division of Lincolnshire, about twenty miles east of Nottingham. The height of our station, but not of the Castle, is 237 feet, lat. 52° 53′ 39″·9 N., long. 0° 3′ 7″·4 W.

WILLIAM INGRAM

Belvoir

Electrical Phenomenon

I BEG to inclose extract from a letter just received from a young friend at Yloilo, and shall be glad if you will insert it in your next issue. Some of your readers may have further information respecting this interesting sight.

THOMAS HIGGIN

Ethersall, Roby, Liverpool, December 15

"*Yloilo, October* 1, 1886

"Last night a most extraordinary phenomenon was visible in the heavens. About 9 o'clock the sky was perfectly clear, all the stars visible, but no moon, when suddenly the whole heavens were lit up as if by electric light, a very large globe of fire became visible (about the size the moon appears when full) and floated slowly northwards. I was in rather a bad position for seeing where it actually went, a house being between me and the horizon. This ball was followed by smaller ones, which were close to the big one, and gradually got smaller, till they appeared like falling stars, only they went much more slowly."

Electricity and Clocks

WOULD any of your readers aid me in carrying out this idea: To make the works of a small striking clock strike the hours on a large bell by an electrical connection.

T. WILSON

Rivers Lodge, Harpenden, St. Albans

BOTANY OF THE AFGHAN DELIMITATION COMMISSION

WHEN, in 1884, it became known that the Government intended sending a Commission to settle the boundary of North-Western Afghanistan, representations were made to the Marquis of Ripon, then Viceroy of India, that it was desirable in the interests of science and commerce that a naturalist should be attached to the staff, and Brigade-Surgeon Aitchison was accordingly appointed in that capacity. Certainly no better choice could have been made, at least as far as botany was concerned, because no other person had the practical knowledge of the vegetation of the region possessed by Dr. Aitchison, who, moreover, is unsurpassed as a collector. As long ago as 1859 he began collecting plants in the Punjab, the flora of which he fully investigated; and later he collected in Scinde and some parts of Kashmir; but this was all done during his leisure hours. In the winter of 1878 he accompanied the troops under the command of General Sir F. Roberts in the advance on Kuram, and subsequently he was attached to the force as botanist, and commenced operations in April 1879. Botanists of all countries know full well what excellent and extensive collections he made during that and the following year, for, with assistance from the Government of India, the results were promptly published by the Linnean Society. Large and interesting as those collections were, the present equals them in extent and exceeds them in importance, inasmuch as Dr. Aitchison paid special attention to the investigation of the many

vegetable products of the Perso-Afghan region which are articles of commerce with India and other countries. Much uncertainty existed respecting the plants yielding some of these drugs, dyes, and other substances, and no more welcome contribution to botanical knowledge could be made than the removal of this uncertainty.

The Commission left Quettah in September 1884, taking a south-westerly direction as far as Nushki, and thence the course was north-westward across Northern Baluchistan to the Helmund River, which was touched in about 63° E. long. This section of the journey produced little, as the country is very barren and the season in which it was traversed the worst of the year for botanising. Nevertheless a few interesting things were picked up, notably ripe fruit and seeds of *Stocksia brahuica*, which were previously unknown. The fruit, or seed-vessel, is an inflated capsule, similar to that of the Chinese *Koelreuteria*, near which *Stocksia* is placed, and so brightly coloured that it bears a name equivalent to "mountain peach."

That part of the journey from the Helmund northward to Kuhsan, a little to the north-west of Herat, was accomplished at the rate of twenty miles a day, therefore there was little opportunity for collecting. Indeed the fatigue attending the travelling was so great that frequent dismounting to secure specimens of natural history was out of the question. In spite, however, of all drawbacks and difficulties, specimens of about one hundred species of plants were dried; and this collection was despatched to India, by way of Herat and Candahar, where it arrived in a rotten condition, having apparently been immersed, probably in crossing some stream, during the transit. The small collection made in Baluchistan had in the meantime reached Kew safely.

The main collection of dried plants, consisting of about 800 species in 10,000 specimens, was made in an irregular tract of country lying between about 59° and 64° of longitude and 34° and 37° of latitude, with Herat near the south-eastern, and Meshed near the north-western limits. This collection was the result of one year's work; yet it by no means represents the entire flora of the area in question, partly in consequence of the difficulties attending the daily transport of collections constantly increasing in weight and size, and partly on account of the necessity for keeping with the main party. These contingencies, rather than the resources of the country, determined the extent of the collection. Thus, for instance, Dr. Aitchison rarely reached an altitude of more than 5000 feet, so that he collected no portion of the vegetation of the upper zone of the country. However, as the mountain flora is of more purely botanical interest, while that of the plains is of special commercial importance, on account of the number of economic plants it contains, its absence is, from the economic point of view, the less to be regretted.

At present the collection has not been fully worked out; but it is estimated that it comprises about a hundred species previously unknown to science, besides largely supplementing the material in herbaria of many obscure plants. Its principal value, however, as already mentioned, lies in the number of usually very complete specimens of economic plants and their products.

Foremost in importance, and the characteristic and dominating feature of the vegetation of the plains, are the *Umbelliferæ*. Some of these are of gigantic size, for herbs, and several of them yield valuable gum-resins, known in commerce as gum ammoniacum, gum galbanum, asafœtida, &c. A special paper on these plants was read by Dr. Aitchison on December 8 before the Pharmaceutical Society, therefore it would be superfluous to enter into details here. Early next year will be published a full and illustrated Report on the whole collection, in which prominence will be given to the economic plants: such as have not previously been figured, or only inadequately figured, will be selected for illustration. Remarkable among the *Umbelliferæ* not known to yield gum-resins are *Ferula oopoda*, Boissier, *F. suaveolens*, Aitchison and Hemsley, and *Dorema serrulatum*, Aitchison and Hemsley. The first we have identified with a described species, though the specimens are very fragmentary, and the description incomplete. It is a most singular plant, in which the bases of the cauline leaves are developed into large circular bowls, through a succession of which, gradually smaller upwards, the stem passes. The largest of these bowls are as much as a foot in diameter, and about two quarts in capacity. From his investigations on the spot, Dr. Aitchison is of opinion that these bowl-like expansions of the petioles do not serve the plant as reservoirs of water: possibly they may prevent the ascent of insects which infest and consume the fruit of many of the Umbelliferæ of the region. *F. suaveolens* furnishes a kind of sambal, and the *Dorema* is a very distinct new one. These *Umbelliferæ* form very beautiful miniature forests; *D. glabrum* growing as much as 10 or 12 feet high.

Among other economic products whose sources have been traced and good specimens of the plants secured, a yellow dye, largely imported into India, may be mentioned. It is furnished by an apparently undescribed species of *Delphinium*. Another dyeing material turns out to be the roots of a species of *Prunus* (*P.* (*Cerasus*) *calycosus*, Aitchison and Hemsley), remarkable in being apetalous; the petals being replaced by the coloured petal-like calyx-lobes. *Pistacia vera* Dr. Aitchison regards as undoubtedly indigenous in this region, and numerous other interesting facts of the same nature will be described in his Report.

In conclusion, it may be mentioned that Dr. Aitchison succeeded in bringing home his extensive botanical and zoological collections by way of the Caspian and Black Seas, in an admirable state of preservation. Of course, it will be understood that there is no difficulty in drying plants in Afghanistan and Persia. In fact, they are likely to get too dry, and consequently break and crumble to pieces in transport, especially when, as in this case, they are carried on camels and mules day after day; and it was only by the most careful and elaborate packing that the plants were prevented from being rubbed into powder.

W. Botting Hemsley

DEPOSITS OF VOLCANIC DUST

In several recently-published papers,[1] Prof. George P Merrill has called attention to some interesting deposits which are shown by careful microscopic study to consist of volcanic dust.

Samples sent by Mr. Zahn, of Nebraska, to the United States National Museum were supposed to be "geyserite," and similar materials are said to occur in Western Kansas, Eastern Colorado, and Wyoming. They were found in small patches or in beds up to four feet in thickness, covered by a considerable thickness of other deposits. Of this material Prof. Merrill writes as follows:—

"A glance at the samples was sufficient to convince the writer that they were not the result of geyser action, but were probably of volcanic origin. One was of almost chalky whiteness, very finely pulverised, and of a sharp, gritty feeling when rubbed between the fingers. The second was gray in colour, slightly coarser, and had, even to the naked eye, a flaky appearance. Submitted to microscopic examination, both samples were found to consist almost entirely of the minute particles of amorphous glass, such as originate from the fine pulverisation of a glassy pumice, with only occasionally a fragment of a greenish mineral that was apparently hornblende."

[1] "On Volcanic Dust from South-Eastern Nebraska" (*Proc. Nat. Mus.* vol. viii. 1885, p. 99; "Notes on the Composition of Certain 'Pliocene Sandstones' from Montana and Idaho" (*Am. Journ. Sci.* vol. xxxii. 1886, p. 199).

The figures given of these particles show that they closely resemble pumiceous dusts (see NATURE, vol. xxix. p. 587). An examination of the sandstones with which these dusts are sometimes found interstratified proved that they consist of well-rounded particles of triclinic feldspar, hornblende, and magnetite, and that they are therefore, like the associated dust deposits, of volcanic origin.

Among a series of so-called "Pliocene sandstones" collected in Montana and Idaho in 1871 by Dr. A. C. Peale, of the Hayden Survey, Prof. Merrill was able to detect similar pumiceous sands in a more or less pure state. In their microscopic characters several of these were found to be very similar to the pumice-dust which was thrown out so abundantly during the great eruption of Krakatão. "All of the above-mentioned dusts yielded water when heated in a closed tube, and fused readily, with swelling, before the blow-pipe. Samples submitted to Mr. J. E. Whitfield, of the Geological Survey, for analysis, yielded results as follows :—

	Marsh Creek Valley, Idaho	Little Sage Creek Mountain	Devil's Pathway
Ignition	6·00	6·50	5·60
Water[1]	1·60	1·12	3·46
$Fe_2O_3 + Al_2O_3$	16·22	18·24	17·18
SiO_2	68·92	65·56	65·76
CaO	1·62	2·58	2·30
MgO	trace	0·72	trace
Na_2O	1·56	2·08	2·22
K_2O	4·00	3·94	3·14
	99·92	100·74	99·66

Accepting the apparently well-founded conclusions of others to the effect that such dusts represent the extreme degrees of acidity of the lavas of which they formed a part, we are led to consider these as of andesitic or possibly trachytic derivation."

Other similar materials have been examined from Bridger Creek, on summit of a hill near Bozeman, and in connection with fossil bones from the Niobara Loup Fork and Sweetwater regions. A sample obtained from the base of the Mazatzol Mountains at the edge of Verde River Valley is stated to be quite similar to that described from the east of the Black Hills of Dakota, described by Dr. Wadsworth,[2] and also to those previously described by Prof. Merrill from Nebraska. Other similar dusts have been obtained by the officers of the United States Geological Survey from Wray Station in Eastern Colorado, and from Norton and Phillips Counties, Kansas.

"In studying the probable origin or sources of these various beds, the distances which the dust can be carried by atmospheric currents is likely to prove of importance. It may therefore not be out of place to state here, that among a collection of pumices, ashes, &c., from the Krakatão eruption in 1883, and which were donated to the Museum by T. H. Houghton, was a small sample of the dust (36974) that 'showered on board ship *Beaconsfield* at the rate of one inch per hour for three days, in latitude 14° S., longitude 92° E., or at a distance of 855 miles from the scene' of volcanic activity. This dust is a very pure, nearly colourless, gray and highly pumiceous glass, the particles of which vary in size all the way up to 0·25 mm.

"As a matter of economic interest I may say in conclusion that in Kansas and Nebraska these dusts are collected and sold in paper packages as 'diamond polishing-powder,' or put into soap which is sold for general scouring as well as for dental use under the name of 'Geyserite soap.'"

[1] Water given off at 105° C.
[2] *Science*, July 24, 1885.

THE POTATO TERCENTENARY

A N article on "The Origin of our Potato," which appeared in our columns on May 6, contained these words: "It would be a fitting observance of the third centenary . . . if we could celebrate it, not by speeches and after-dinner toasts to the memory of Drake or of Ralegh, but by clearly laying down our lines of inquiry, for they have been very ill-defined." These words, penned by our contributor with then no definite idea as to the way in which various thinkers could be brought together to help to lay down lines of inquiry, have had their effect. The proprietors of the St. Stephen's Hall took the subject up, and in a circular headed 1586-1886, printed in old English type, referred to the article in NATURE as drawing attention to the fact that 1886 was the accepted date for the tercentenary, and announcing their intention to celebrate it in the spirit suggested, with Conferences and an historic and scientific Exhibition, conjoined with a display of all known varieties of tubers that could be obtained. A "Scientific Committee of Consultation" readily offered their services to arrange the "historic and scientific" portions of the Exhibition and to conduct the Conferences. Leaving, as it was seen we were, the old lines of cultivation, and entering on a more thoughtful, a more scientific way of procedure, the turning-point appeared to demand a recognition of the past, an exposition of present knowledge, and something tangible of the on-look into the future.

The proprietors of the St. Stephen's Hall, while acting as the executive, and arranging the display of tubers, and offering gold, silver, and bronze medals, left all the scientific work to the Committee of Consultation. Those who first accepted their responsibilities had to seek the co-operation of others, and only those who were specialists in the portion of the subject they represented were invited to join it. In the list of sections as drawn up, the botanical aspects of the question naturally came first, and Mr. J. G Baker, F.R.S., of Kew, undertook to illustrate "The Known Wild Species of Solanum," which he did partly by dried specimens and partly by drawings. No one was found to undertake the section "Batatas, yams, ighnamas, &c., that in Elizabethan times were called potatoes," but specimens of yams and so-called batatas were shown. Some uncertainty about the vernacular nomenclature of these seems to exist. The section "Cultivation by the Incas and other Andean Nations" was accepted by Mr. C. R. Markham, C.B., F.R.S., who in the Conference added more information than could be given in the form of an exhibit. For the next section on the programme, "Early Cultivation in the British Isles," no one could be found. This is a fact worth notice. There must surely be some one who has paid attention to this subject, yet even after the Committee was fully formed it was not known to whom to apply for information.

The next section, "Cultivation," with its sub-sections —(1) Selection, (2) Cross-breeding, (3) Hybridisation, (4) Grafting—was undertaken by Dr. Maxwell Masters, F.R.S.; and the following section, "Potato-disease," was well filled up with contributions from Mr. W. Carruthers, P.L.S., Mr. Worthington Smith, Dr. Plowright and Mr. Geo. Murray, F.L.S. For the section "Chemistry of the potato and batata as a food" Prof. Church sent new analyses, and Mr. W. Topley, F.G.S., of the Survey, contributed maps and notes on "Soils suitable for Potatoes geologically considered."

In "Meteorology as affecting Disease," Mr. J. G. Symons, F.R.S., exhibited rainfall maps showing coincidence with special disease years. The next section, "Historic literature of the potato," was in charge of Mr. W. S. Mitchell, M.A., and by the help of dealers in old books, and of private collectors, the list he had drawn up had but one gap—a Monardes. Such a collection has no before been brought together. The section "Maps showing the knowledge of the New World at the time of Elizabeth"

was formed by the help of Mr. Coote, of the Map Department of the British Museum, Mr. C. R. Markham, Mr. Henry Stevens, and others. For the section "Ralegh" Dr. Brushfield, of Salterton, Devon, sent up his collection of works, which, with some additions, were arranged by Mr. H. B. Wheatley, F.S.A.; while the "Drake" section was mainly composed of an interesting series of illustrations sent up from Plymouth by Mr. W. H. K. Wright, of the Public Library. Mr. B. D. Jackson, Sec. L.S., contributed the works illustrating the "Gerard" section; but no one could be found to supply any information about Heriott, as that section was blank.

It is worth noting that this Exhibition was not one in which the list of sections followed what was sent in. What ought to be shown was drawn up first, and where the required works or maps, &c., could not be obtained the blank was understood.

Many unexpected curiosities arrived. Potatoes from Youghal, co. Cork, where it is said Ralegh planted his first potatoes in Ireland, were sent, together with views of his residence there where he conversed with Spenser. Irish cooking-pots of the same type as those in use 300 years ago, and rough garden, or possibly field, tools, were also sent over. Potato-culture in every aspect was represented, except in illustrations of the new methods of artificially fertilising by removing pollen from one flower to another.

As regards the show of tubers, the judges, Messrs. Shirley Hibberd, William Earley, and R. Dean, considered them well worthy of the occasion. The especial aim was that every known variety should be represented, and there was a special section for new varieties, introduced within the last two years, not yet in the market. The prize-winners of the medals offered by the executive have been made known in journals devoted to these subjects.

The Exhibition itself dealt with the past, including in that, history from the time of Ralegh and Drake down to the recent past,—Mr. Baker's work on distinct wild species of tuber-bearing Solanums, which he has reduced from six to four since his paper at the Linnean Society was read.

The chief scientific importance of the celebration of the tercentenary, however, lay in the Conferences.

At the opening, Mr. W. Carruthers, P.L.S., took the chair, and the first paper was read by Mr. W. Stephen Mitchell, M.A., on "Historic Consideration of the Question, whence came the Potato to England." Alluding to articles he had written, he said it was easy to see how the mistake had arisen that the introduction of the potato had been attributed to Ralegh, and that Virginia had been regarded as its original home; and he expressed his belief that Drake brought it from Carthagena in his 1586 expedition, on which expedition he had asked his friend, Mr. W. H. Pollock, to contribute a paper. This paper (read in the writer's absence by Sir Richard Pollock) detailed the expedition, and showed that there was opportunity for Drake to have taken on board the potato as ship's-provender at Carthagena. The supply at Carthagena depended on native cultivation. Then in due sequence followed Mr. Clements R. Markham's paper on "The Cultivation by the Incas and other Andean Nativon." This paper proved to be the surprise for the Conference. The cultivation by the Incas was already fairly well known, as our article of May 6 showed, from the writings of Garcillasso de la Vega, Acosta, and Cieza de Leon. But the cultivation by the Chibchas was the revelation. Not only have the people died out, but their language has been lost. A *vocabulario*, however, has preserved many of the words they used, and nine varieties of potato are in it named. It is thus seen that before the Old-World people (the Spaniards) reached the New World, the potato had been so long cultivated, and that distinct varieties were recognised. Mr. Markham most eloquently described the high civilisation of the Incas, and with a large-scale lecture-map, belonging to the Royal Geographical Society, showed the regions of potato-cultivation as they can be inferred from early writers. Following most appropriately on this was Mr. J. G. Baker's paper on wild species of potatoes as known to botanists at the present day. In the discussion which followed, there was naturally raised the question, What are wild species, and what were cultivated by the Incas and other neighbouring peoples? but, of course, no definite answer could be given. This is one of our troubles. Mr. Markham's paper was also of very considerable interest. M. Henri de Vilmorin then gave a brief account of what he had been able to ascertain about the introduction of the potato into France, which he hopes to be able to work out more fully. This concluded the historic portion of the work of the Conference. Then Mr. George Murray, F.L.S., of the British Museum, gave an account of the history, of the study, and of the present state of our knowledge of the potato-disease. The facts he mentioned have already appeared in these columns. The day's work ended with a vote of thanks to the Chair, proposed by Earl Cathcart.

On the second day of the Conference, Mr. W. S. Mitchell in the chair, the first paper read was by Dr. Maxwell Masters, F.R.S., "On the Production of Varieties by Cultivation." It embodied the thoughtful appreciation of past work, and what has to be done in the future. It is on hybridisation our hope must mainly rest, on a cross by artificial fertilisation between two distinct species, all other "cultivation" being but a continued ringing of changes. It was, from a practical point of view, the most important communication made to the Conference. The following papers by Mr. W. Earley, Mr. A. Dean, and Mr. R. Dean took up the question of cultivation from the grower's point of view, and coming as they did from such recognised practical men they were of value. Mr. Hibberd criticised, from his own experiments, the value of the Jensen system of earthing-up, and stated his belief that it did not add to the crop, even if it might, as asserted, prevent disease from spreading. He suggested, and backed up his suggestions with reference to his own experience, that the early raising of a crop showing signs of disease was of use. The period for doing this, however, he did not mention, and to raise a crop before the starch is formed in the tubers would be of little real value. The suggestion, however, is one of importance for future consideration. He detailed an unintended experiment made during the last twelve months which is worth the attention of practical men. It will reach them through horticultural journals. Mr. R. Dean, in his paper, admitted that, although he had thought potato-culture was thoroughly "threshed out," he had come to see much remained to be done. The aim of the cultivator had been to produce handsome table tubers. Sufficient attention had not been paid to degeneracy and the causes of it. Again, though it is very well to produce new varieties, the trouble is to get them into general use. People will follow their old lines. In the course of his paper he advocated deep tilling. Mr. A. Dean, in reading on "Raising new varieties of potatoes," referred to the fact that some cultivated varieties do not produce any flowers, and some with flowers do not mature pollen. He detailed several experiments in crossing, and especially drew attention to varieties that do or do not produce much haulm. As it is through the leaves on the haulm that the disease reaches a plant, this is a matter of importance. In the course of the discussion Mr. Ap Thomas gave some valuable information about potatoes in South America, and Earl Cathcart expressed the hope that the information should be in some form preserved.

After the usual votes of thanks had been passed, the generally expressed opinion in conversation was that the Exhibition should have been open for four weeks instead of four days. That the Conferences, by bringing together

people who view the whole subject from different standpoints, have done good appears to be admitted. The future will show.

NEW ZEALAND COLEOPTERA[1]

IN an important memoir quite recently published, Dr. Sharp describes a large number of new species of Coleoptera from New Zealand. Although the entomology of these islands is of considerable interest, it is still very imperfectly known, and a quite erroneous idea as to its poverty is very often found to exist. Linnæus knew of no Coleoptera from the group, but a small number had been obtained by the naturalists of Capt. Cook's voyage. Some of these were described by Fabricius about a century ago, and a few of these are still to be found in the Banksian Collection at South Kensington, but from Cook's day until the date when the island was visited by Her Majesty's ships *Erebus* and *Terror* little was done in the way of investigation. When Adam White published the account of the Coleoptera of this last Expedition (1846), he enumerated all the species of the group known to date to inhabit New Zealand, and the total was about 150; however, between 1866 and the present time, the greatly increased activity of collectors swelled the number of species known to nearly 1500, and in the memoir we are now noticing Dr. Sharp describes 141 additional forms. Dr. Sharp still, however, regards the Coleopterous fauna as very incomplete, and on the consideration of such data as he possesses ventures on an estimate that between 3000 and 3500 species will probably be found in New Zealand; so that there is an immense field still open for collectors. The fauna so far as known is very analogous to that of Europe in extent and complexness. The species when examined show similar structures, exhibiting analogous gradations and cross affinities, but the New Zealand insects possess a larger proportion of forms in which the structures are less perfect—comparatively, as it were, little evoluted. In brilliancy of colour and in large and conspicuous forms, the New Zealand Coleoptera are very deficient, but to the specialist they make up for this in the interest attaching to many of them as isolated forms having, so far as is at present known, little or no connection with the ordinary Coleopterous fauna of the island.

While the data are so imperfect it is obvious that no reliable answer can be given to the question of the affinities of the New Zealand fauna; but Dr. Sharp, from what is known, entertains the impression that it will be in the Chilian and Patagonian fauna that the greatest amount of affinity will be found, and that, while numerous points of propinquity with the Australian fauna undoubtedly exist, yet they are rather exceptions dealing with isolated forms, and but little affect the mass of the fauna.

Lasiorhynchus barbicornis is the only member of the Brenthidæ found in New Zealand, and is perhaps the most remarkable beetle of the islands; it must be considered a highly evoluted form, the sexual differentiation being great, with remarkable male characters, large size, and considerable perfection of general structure, and while it appears to be quite foreign to the New Zealand fauna, it would seem to have no really close ally in any other country.

Another isolated form, of large size, for many years known, but still a great rarity, is Dendroblax. Its position has never been satisfactorily fixed; it has no ally in New Zealand, and no near ally out of it. Such cases are extremely difficult to explain. Dr. Sharp thinks it possible that there has been going on in New Zealand, for an enormous period of time, the evolution of a fauna parallel with that of the continents of the world, and that during this period it has occasionally received intrusions from other countries, some of which have continued to evolute since their introduction, while others have remained with little change. On such a view Dendroblax might be an ancient intrusion into New Zealand, which has become extinct elsewhere, and has evoluted but little in New Zealand; while Lasiorhynchus might have evoluted much since its introduction.

This memoir forms a part of the *Scientific Transactions* of the Royal Dublin Society, and both as regards the paper and press-work it is extremely creditable to the Society. The two quarto plates contain fifty figures of the new species described. These are from the pencil of Baron Schlereth, of Vienna, and are among the best illustrations of Coleoptera we have seen. The plates have been printed after a new and brilliant process by Bannwarth, of Vienna.

[1] "On New Zealand Coleoptera, with Descriptions of New Genera and Species." By David Sharp, M.B. With two plates. (Dublin, 1886.)

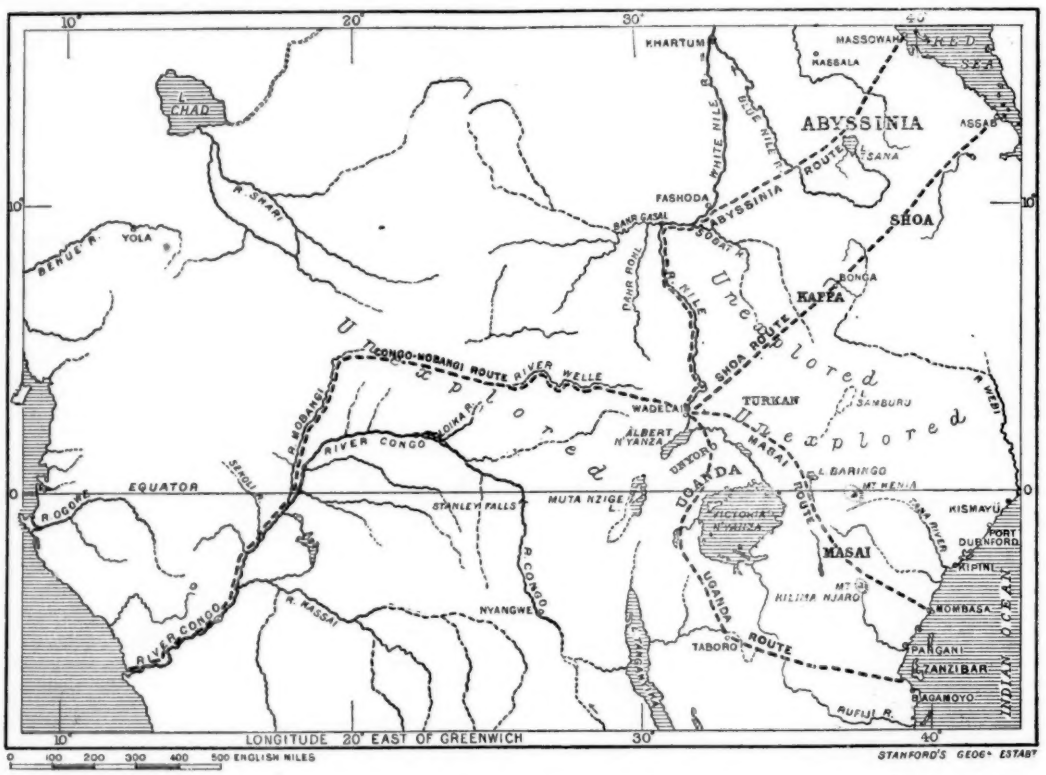
THE RELIEF OF EMIN PASHA

EVERYBODY seems agreed that Dr. Schnitzler, better known as Emin Bey, but recently created Emin Pasha, ought to be relieved; for he does not want to be rescued. For ten years he has been in the Egyptian service, for most of that time as Governor of the Equatorial Province, which, in spite of the Mahdi and his hordes, the death of Gordon, and the collapse of the Egyptian Soudan, he continues to administer with success, and to the comfort and satisfaction of all but slavers. What Emin Pasha has done for science in the little leisure left him by his arduous duties, the readers of *Petermann's Mitteilungen* and the *Proceedings* of the Zoological Society know. He is a good type of the kind of explorer that is wanted now that mere pioneering work has been pretty well exhausted: a man well qualified by his scientific training to remain in a particular region for years if necessary, and study it in all its aspects. We have had such men in the past: some of the greatest names in science could be mentioned as examples. We do not insist in these pages on the great services which Emin Pasha has rendered to civilisation during his residence in the Soudan, first as the noble-minded Gordon's lieutenant, and latterly as one who, in the spirit of Gordon, resolved to stick to what he conceived to be the post of duty at all hazards. Our own Government has virtually admitted its responsibility for the present position of Emin Pasha, but has weakly attempted to shirk its duty by devolving the business of relief on private individuals. Should disaster happen, however, to Emin Pasha or to any expedition sent to his relief, we may be sure that public opinion will not blame any private individuals. Government, however, has gone so far as to promise every assistance short of contributing money.

It is unfortunate that already there has been a delay of several months since first we knew of Emin Pasha's critical position, and since first the Intelligence Department began to make inquiries as to the best route for a relief expedition. Even now, when an expedition has been decided upon, there seems little prospect of a speedy start. Surely, if those to whose hands the 10,000*l.* contributed by the Egyptian Government have been intrusted had the interests of Emin Pasha solely at heart, a competent leader would have by this time been within hail of Zanzibar. A better leader, under the conditions, than Mr. Stanley could probably not be found; but surely there has been unnecessary delay in deciding to send him. The idea of more than one expedition is entertained by many; and, as our map will show, the most direct and safest route is by Masai Land, about which we now know so much through the journeys of Mr. Thomson and the late Dr. Fischer. Dr. Junker telegraphs from Zanzibar that a relief expedition is urgently necessary, and that as fighting is inevitable, Mr. Stanley ought to be sent. By the Masai Land route, as shown on the map, avoiding Unyoro

and Uganda, and skirting Lake Baringo and Turkan, we doubt if any fighting would be necessary. We have reason to believe that the King of the Belgians will not object to Mr. Stanley undertaking an expedition, and that Mr. Stanley will choose the East Coast route, but whether through Masai Land, or by the the west side of Lake Victoria Nyanza, and so on to Albert Nyanza, remains to be seen. What geographers would like most of all, would be an expedition by the Congo and Mobangi Rivers. In this way, not only would fresh discoveries be combined with the relief of Emin Pasha, but, by sending out two independent expeditions, the latter would almost certainly be accomplished.

Our map is intended to show the various routes that have been proposed. There is, first, the Masai Land route described above, the total length of which, to Wadelai, where Emin Pasha is stationed, is only 820 miles, and thus is the shortest of all the routes. Mr. Thomson has traversed this route to within 300 miles of Wadelai, and these 300 miles are as yet unexplored. The most formidable difficulty here would be the bellicose Masai, but these, Mr. Thomson has shown, can, after all, be managed. By keeping well to the east, there would be little danger of the cruel young potentate of Uganda hearing of the expedition, and so the lives of missionaries and native Christians would not be endangered. Next is the Uganda route, which is understood to be favoured by Mr. Stanley, and which is 1050 miles in length, and all previously traversed. Most tempting of all the routes, if exploration were the only object in view, would be the Congo-Mobangi route. The Mobangi is one of the greatest of the tributaries of the Congo, and



has been navigated for about 250 miles by Mr. Grenfell. On the other hand, Dr. Junker has been down the Welle-Makua to 22° E., within about 200 miles of Grenfell's farthest. Now, if we were certain that the two rivers were one, in spite of the rapids on the Makua this is a route we should be strongly inclined to support. But no risks should be run and no experiments tried in a matter so critical. By all means send an expedition by this route, and solve one of the few remaining hydrographical problems in African geography. We must say, however, that those best acquainted with the levels in this region still maintain that the Welle does not come down to the Congo at all, or, if it does, not by the Mobangi. This route is 1900 miles in length. The Abyssinian route, in our opinion, does not deserve any consideration so far as the relief of Emin Pasha is concerned, though there is some exploring work to be done in this direction. The total length from Massowah to Wadelai is 1400 miles,—Massowah to Fashoda 700 miles, of which at least one half is unexplored, and from Fashoda to Wadelai by the Nile about 700 miles. In the same category as the Abyssinian route is the Shoa route—1050 miles, from Assab to Wadelai, 300 miles being unexplored. There is also a rumour that the King of the Belgians intends to send Mr. Stanley up the Nile, but this is a rumour that can scarcely be credited.

Altogether it seems evident that, if Emin Pasha is to be reached with the least possible delay and with substantial relief, the Masai Land route is the one to take. There is one important consideration that must be mentioned. With a caravan consisting solely of men they could take only what they themselves would consume, and it is difficult to see how a supply of ammunition and

other necessaries could be conveyed. Now, by Masai Land it is all but certain that camels could be utilised, and these animals could find their own provender. With 30 or 40 camels and 60 donkeys, very substantial relief could be taken to Emin Pasha. Indeed, the whole route, at least to the borders of Emin Pasha's province, is so comparatively level that Cape wagons could be taken, though in such an expedition it would not be advisable to try the experiment. The important thing is that there should be no further delay in starting at least one expedition, whoever the leader is to be.

Mr. Stanley was to arrive at Southampton yesterday, and we may be sure that if there is any delay in getting an expedition under way he will not be to blame.

NOTES

On the 15th inst. a meeting was held of the Association for Promoting a Teaching University for London, when the Committee presented their second report. At a meeting held in December 1885, the Committee were instructed to open communications with the governing bodies of the University of London, University College, King's College, the Royal College of Physicians of London, the Royal College of Surgeons of England, and the various Medical Schools of London, as well as with the Council of Legal Education, for the purpose of promoting the objects of the Association on the basis of that report. The Committee have been informed by the Senate of the University of London and by the Councils of University College and King's College, that committees of those bodies had been appointed to consider the objects and proposals of the Association. The Council of King's College have adopted a resolution to the effect that "the Council, while reserving their opinion as to the details of the scheme laid before them by your Committee, approve generally of the objects which the Association has in view." The subject having been brought before the Council of University College, they adopted a resolution to the following effect:—"That this Council do express a general approval of the objects of the Association, which are as follows:—(1) The organisation of University teaching in and for London, in the form of a teaching University, with Faculties of Arts, Science, Medicine, and Laws; (2) the association of University examination with University teaching, and direction of both by the same authorities; (3) the conferring of a substantive voice in the government of the University upon those engaged in the work of University teaching and examination; (4) existing institutions in London, of University rank, not to be abolished or ignored, but to be taken as the bases or component parts of the University, and either partially or completely incorporated, with the minimum of internal change; (5) an alliance to be established between the University and the Professional Corporations, the Council of Legal Education as representing the Inns of Court, and the Royal Colleges of Physicians and of Surgeons of London." A conference between the deputation of the Committee named in that behalf and the Committee of the Senate of the University of London was held on November 23 at the University of London; and, at the conclusion of a long and important discussion, the Vice-Chancellor gave to the deputation the assurance that the general disposition of those present was to move in the direction indicated by the Association. Various other institutions have virtually expressed approval of the object of the Association, and, while awaiting some further communication from the Senate of the University of London, which it is understood will be made, either to them, or in an independent way to the University teachers of London, the Committee propose to take steps for bringing to the notice of Her Majesty's Government the need which exists for the co-operation of the Government and of the Legislature, in order to place University teaching in London on a more satisfactory basis.

In connection with the report referred to above, the *University College Gazette* of December 17 contains a long article sketching briefly the career of University College, and alluding specially to the results of its severance from the University. The University, the article maintains, has carried out with great success, and to the great benefit of many workers, its design of a testing machinery that should enable it to throw its degrees open to all the world, without restrictions of any sort. It has grown to be a great Imperial University. Whatever faults there may be in its imperial system are of a kind to be corrected in the ordinary course of administration as time proves the need. On the side of the University of London, there is leisure now to go back to the point of separation from the Colleges, and having done one part of its work well, see that it does not leave the other undone. On the side of the Colleges, and of London itself, there is now a determination that the chief city of the world, abounding in the best elements of a true University life, shall not remain without a teaching University. The first aim of University College, the article goes on to say, is to form an alliance with the present University, by large expansion of its powers. "The desired work can be done so much more thoroughly by the University in concert with the College, and the issues are so important for their influence on the London of the future, that, if the result of the present deliberations at the London University were but faintly satisfactory, effort towards united action should be steadily continued by our College. Not until it has been proved (apart from rash assumption) that the desired concert cannot be obtained, should we consider that the time had come for advancing our next line of battle. Then it must be our resolve to apply all our powers to the creation of a separate teaching University in London; to the resuming of our first battle, and recovering for University College the position it gave up on conditions that are no longer fulfilled. King's College will join forces with us, but with or without allies we must press on to victory, and in this form of the battle, should we be forced to it, we depend on ourselves; we shall have public feeling with us, and the fault will be ours if we fail."

The death is announced, on Friday last, of Sir Douglas Forsyth, at the age of fifty-nine years. He will be best known to science as the leader of the mission to Kashgar, the report on which, only recently completed, forms so valuable a contribution to the natural history of Central Asia.

It is evident that at Rodriguez, a small dependency of Mauritius, the indigenous plants are threatened with extinction from an enemy of a peculiar character. In the Annual Report of the Acting Civil Commissioner on Crown Lands and Forests for 1885 it is stated:—"In my report for the year 1884, I pointed out the existence of a kind of white lice, commonly called here 'cochenille,' which had in a very short time multiplied enormously, and threatened to destroy the forests of Rodriguez. During the year 1885 matters looked more alarming still. It was reported to me that these insects had begun to attack the maize, manioc, and bean plantations: I myself while visiting the mountain ascertained the correctness of the report. However the bean harvest had not been bad, and the inhabitants had not to suffer from any scarcity of food. As regards the citron, lemon, and orange trees, for which this island has long been famous, hundreds of them have been killed by these insects. The mango and cocoanut trees felt their baneful influence, and yielded sour and unsavoury fruits. One of the best forest trees which grow here, the 'Bois puant' (*Fœtidia mauritiana*), seems unable to resist their attack, and I am afraid that there will not be one of these trees left within a

twelvemonth, unless, by some happy circumstance, these insects were to disappear altogether." We learn from Kew that the interesting indigenous tree, whose complete extinction within twelve months is here anticipated, is very rare in Mauritius, and unless steps are taken to preserve it at Rodriguez, it will probably disappear altogether as a forest tree from the flora of these islands.

A MEETING of students anxious to form a Biological Society in connection with University College, London, was held on Monday, the 13th, in the Zoological Theatre, Prof. Lankester in the chair. The provisional Committee appointed at the first meeting submitted to the Society the rules they had drawn up, which after some discussion were passed with slight amendments, and sent up to the Council for approval. Many lady-students were present at this meeting, and so strong is the wish on all sides that they may be admitted to the Society, especially as the classes of Botany and Zoology have been thrown open to them, that two lady-students were put up as candidates for the Committee, and only missed election by a few votes.

AT a meeting of biologists held in the Natural History laboratory, University College, Liverpool, on Saturday, December 11, it was resolved to found a Biological Society in Liverpool, to have for its object the study and advancement of zoology, botany, palæontology, anatomy, physiology, and embryology, and the publication of papers of scientific value on any or all of these subjects. The following gentlemen were elected as office-bearers for the ensuing year:—President: Prof. W. Mitchell Banks, M.D., F.R.C.S.; Vice-Presidents: James Poole, J.P., Mayor of Liverpool, and Prof. W. A. Herdman, D.Sc., F.R.S.E.; Treasurer: J. C. Thompson, F.R.M.S.; Secretary: R. J. Harvey Gibson, M.A., F.R.S.E. It was decided to hold the first meeting of the Society at University College on Saturday, January 15, 1887, when the work of the Society will be initiated by the delivery of an inaugural address.

DURING a recent voyage of the U.S.S. *Juniata* to South America, observations were made as to the height and length of waves, with the following result, as reported by Commander Davis: height of wave from hollow to crest, 25 feet; length from crest to crest, 375 feet; wave-period, 7·5 seconds. The wind-velocity at the time was 10 miles per hour. The height of wave was measured by the elevation at which an observer could see over the crest when the ship was in the hollow. The wave-period was estimated by counting the average number of waves per minute. The wave-length was determined by the time occupied by the crest in passing a measured portion of the vessel's length.

IT is stated that the task of working up the materials collected by the survey parties of the Afghan Boundary Commission during the past two years into a regular series of maps has been undertaken by Capt. Gore, R.E., and that it will be carried out at Dehra Dun.

HIGHER mathematics in its applications to social problems is the subject dealt with in a new Vienna journal, *Die Controle*, which is edited by the mathematician, Dr. Grossmann. In an appendix, entitled "Die Mathematik im Dienste der National-œkonomie," questions of national economy are treated on a mathematical basis.

PROF. DEWAR'S course of six lectures on the Chemistry of Light and Photography (adapted to a juvenile auditory) which begin on Tuesday next (December 28) at the Royal Institution will be very fully illustrated. Arrangements have been made for the introduction of a powerful beam of electric light, equal in intensity to a sunbeam, into the theatre, for photographic experiments. Many improvements have been made in the warming, lighting, and ventilation of the theatre during the autumn recess.

THE last mail from Singapore brings news of the death there, on November 29, of Mr. William Cameron, explorer and geologist to the Government of the Straits Settlements, at the age of fifty-three. Mr. Cameron, after an eventful life in England and Australia, settled down in the Straits Settlements, where his practical knowledge of mineralogy and geology, combined with his love of exploration, procured him several appointments. Lately he had been employed by the Colonial Government in exploring and mapping out the unknown parts of the Native States, and he received the title of Government Explorer and Geologist. The production of one of his maps of these States has recently been noticed in these columns. He was well known throughout the Native States, especially amongst the Malays and Sakies, of whose language and customs he is said to have had a most accurate knowledge, and over whom he had great influence.

ON December 18 the fine new Ethnological Museum at Berlin was ceremoniously opened by the Crown Prince, who was accompanied by the Princess. The Museum, which is a very fine large building, contains collections from all parts of the world, including the antiquities dug up by Dr. Schliemann at Ilion. Herr Gossler, the Minister of Public Worship, read an address on the nature and objects of the institution, and the Crown Prince in replying referred among other things to the benefits which had accrued to the Museum from the colonial expansion of the Empire.

AT the last meeting of the Paris Geographical Society, M. de Lesseps was in the chair. After having heard an account of an exploration in the Panama Isthmus by M. Désiré Charnay, the Chairman spoke about the canal. He said that, if necessary, sluices should be constructed, so that the canal should be opened at any price in 1889. Ulterior steps should be taken for dispensing with them.

WE have received the report of the Leicester Literary and Philosophical Society for the past year, and also the first number of the new quarterly series of the *Transactions*. The reports from the various sections contained in the former are in all respects but one eminently satisfactory, as they show great activity and excellent work. The exception is Section B, for astronomy, physics, and chemistry, in respect to which it is stated that there is "a lack of interest in Leicester in physical science, especially when real work is to be done." Indeed, it has become a question whether the Council should not be asked to terminate the existence of the section; but "the Council express a hope that the section may live through its time of depression, and, when the interest in physical science has revived, may regain its vigour." We are glad to observe that the botanical sub-committee, who have undertaken and are now editing a work on the flora of Leicestershire, have nearly completed the printing of the book, and hope to be able shortly to announce its publication. The *Transactions* will in future be published quarterly, in place of annually with the Council's report. Of the first quarterly number of the *Transactions* little need be said. It speaks well for the prosperity of the Society that the annual publication no longer supplies its requirements, and the high standard of the papers read is shown by the fact that a number of them have been published by scientific periodicals of repute. The papers now published deal mainly with scientific subjects connected with Leicestershire, such as the Campanulas of that county, the Lower Lias and Rhætics in the Spinney Hills, Leicester, &c. Special mention should be made of a very interesting chart by Mr. Montagu Browne, giving the dates of arrival of summer birds of passage in Leicestershire, from 1843 to 1855, and from 1877 to 1886.

WE understand that Mr. H. S. Vines is intending entirely to re-cast and almost re-write his edition of Prof. Prantl's "Ele-

mentary Text-Book of Botany," and that his new work may be expected from Messrs. Swan Sonnenschein and Co. in the course of next year. In the meantime the publishers are re-issuing the existing book without alteration.

In the annual report of the Leyden Museum for the year ending September 1, 1886, Dr. Jentink, the Director of the Museum and the successor of Prof. Schlegel, is able to report substantial progress with the zoological collections, the most noticeable additions being an egg of *Æpyornis maximus* and a skeleton of *Echidna bruijnii*. Considerable series of animals of all classes have been added to the Museum from the travels of Mr. Stampfli in Liberia and Mr. Van der Kellen in Benguela.

According to the *Colonies and India*, the last experiment in sending salmon-ova to the antipodes appears to have been a great success. In January 1885, a shipment of eggs was made by Mr. James Youl, by desire of the Tasmanian Government, and the bulk of the eggs reached the colony in good condition, development of the embryo having been suspended by means of Haslam's refrigerating machinery. The eggs have developed into "fry," and the "fry" into "smolts," for several young salmon about 8 inches long have been captured accidentally in the Tasmanian Mersey.

The same journal states that a Mining Institute has been successfully launched at Sydney, with a programme of future work calculated to increase the welfare of the mining industry.

In the Reingraben slate of Polzberg, near Lunz (Austria), among other fossils a well-preserved skull of Ceratodus has been found. Two years ago a flat-pressed vertebral column was found in the same place, which seems to have belonged to the same animal.

The additions to the Zoological Society's Gardens during the past week include a Red-handed Tamarin (*Midas rufimanus* ♀) from Surinam, a Mauge's Dasyure (*Dasyurus maugæi*) from Australia, presented by Mr. Robert J. Hamilton; two Collared Peccaries (*Dicotyles tajaçu*) from South America, presented by Mr. Thomas Bell; two Peafowls (*Pavo cristatus* ♂ ♀) from India, presented by Mr. Richard Hunter; two Indian Crows (*Corvus splendens*) from India, presented by Lord Lilford, F.Z.S.; a Yarrell's Curassow (*Crax carunculata*) from South-East Brazil, a Razor-billed Curassow (*Mitua tuberosa*) from Guiana, a Red-billed Tree Duck (*Dendrocygna autumnalis*) from America, two White-faced Tree Ducks (*Dendrocygna viduata*) from Brazil, presented by the Rev. W. Bramley Moore; four Herring Gulls (*Larus argentatus*), British, presented by Capt. S. T. Sargent; six Spectacled Salamanders (*Salamandrina perspicillata*) from Italy, presented by Prof. H. H. Giglioli, C.M.Z.S.; a Macaque Monkey (*Macacus cynomolgus*), an Isabelline Bear (*Ursus isabellinus* ♂) from India, deposited.

OUR ASTRONOMICAL COLUMN

Barnard's Comet.—This comet has become an exceedingly interesting object, of no small beauty and brightness. Prof. Cacciatore, Director of the Palermo Observatory, in a letter appearing in the *Giornale di Sicilia* of December 1, speaks of it as visible to the naked eye. He says:—"Its head shines as a star of the fifth magnitude, and is accompanied by two tails, the one directed to the north-west, of a length of about a degree and a half, and the other to the west, about half a degree in length." But few observations would seem to have been made of the comet in this country, when the comparative brilliancy of the object is borne in mind; still, several English observers have called attention to the second tail. One observer speaks of the brighter tail as being, on December 9, more than 10° in length, and visible to the naked eye; the second tail, which was inclined at an angle of 40° to the other, was much fainter and shorter, and required an aperture of about 2 inches to show it well. The comet is now receding rapidly both from the earth and sun, and as its declination is diminishing, it will soon be lost to English observers.

Rotation-Time of the Red Spot on Jupiter.—Prof. Young, in the December number of the *Sidereal Messenger*, gives a fresh determination of the rotation-period of the great red spot on Jupiter. The determination rests upon eight observations made in the spring of the present year, and the rotation-period deduced is 9h. 55m. 40·7s. ± 0·2s.; the probable error of a single observation being ± 44s. This rotation-period shows that the gradual retardation of the period still persists, the following having been the values deduced in former years:—

		h.	m.	s.
In 1879	Mr. Pratt made the period	9	55	34·9
1880–81	Mr. Hough ,,			37·2
1882–83	,, ,,			38·4
1883–84	,, ,,			38·5
1884–85	,, ,,			40·1

Prof. Young remarked the apparent overlapping of the southern belt and the red spot which took place towards the end of March and the beginning of April, and which was observed by many English observers (*Observatory*, May 1886, p. 188); but, whilst admitting that it was impossible to say which was uppermost, Prof. Young was inclined, in opposition to Mr. Denning's view, to believe the red spot to be the lower. Mr. Denning has pointed out that the apparent partial coalescence of the two markings was simply due to an arm of the southern belt overtaking the red spot, the former having a rotation-period shorter by about 19s. than the latter. Prof. Young observed a white spot in a yet higher latitude than this part of the southern belt, and deduced a period of rotation for it of 9h. 55m. 11·14s. It would thus appear that the red spot moves more slowly than the markings on either side of it, to the south as well as to the north.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 DECEMBER 26—1887 JANUARY 1

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on December 26

Sun rises, 8h. 7m.; souths, 12h. 0m. 51·4s.; sets, 15h. 54m.; decl. on meridian, 23° 22′ S.: Sidereal Time at Sunset, 22h. 14m.

Moon (one day after New) rises, 8h. 32m.; souths, 12h. 56m.; sets, 17h. 22m.; decl. on meridian, 18° 54′ S.

Planet	Rises h. m.	Souths h. m.	Sets h. m.	Decl. on meridian ° ′
Mercury ...	6 18 ...	10 28 ...	14 38 ...	20 50 S.
Venus ...	8 35 ...	12 25 ...	16 15 ...	23 49 S.
Mars ...	9 47 ...	13 57 ...	18 7 ...	20 55 S.
Jupiter ...	2 32 ...	7 40 ...	12 48 ...	10 52 S.
Saturn ...	17 6* ...	1 10 ...	9 14 ...	21 44 N.

* Indicates that the rising is that of the preceding evening.

Variable Stars

Star	R.A. (1887·0) h. m.	Decl. (1887·0) ° ′		h. m.	
U Cephei ...	0 52·3	81 16	N. ... Dec.	28, 0	24 *m*
Algol	3 0·8	40 31	N. ... ,,	27, 0	58 *m*
			,,	29, 21	47 *m*
λ Tauri ...	3 54·6	12 10	N. ... ,,	28, 4	27 *m*
			Jan.	1, 3	19 *m*
δ Libræ ...	14 54·9	8 4	S. ... Dec.	27, 20	7 *m*
			,,	30, 3	58 *m*
U Coronæ ...	15 13·6	32 4	N. ... ,,	27, 17	40 *m*
			,,	31, 4	31 *m*
R Serpentis ...	15 45·5	15 29	N. ... ,,	29,	*M*
β Lyræ ...	18 45·9	33 14	N. ... ,,	28, 0	0 m_2
			,,	31, 5	0 *M*
R Lyræ ...	18 51·9	43 48	N. ... ,,	29,	*m*
δ Cephei ...	22 25·0	57 50	N. ... ,,	26, 21	30 *m*

M signifies maximum; *m* minimum; m_2 secondary minimum.

Meteor-Showers

On December 30 and 31 slow bright meteors fall from a radiant near 2 Lyncis, R.A. 92°, Decl. 57° N. Other showers of the season radiate from near ζ Ursæ Majoris, R.A. 201°, Decl. 57° N., and from near β Bootis, R.A. 221°, Decl. 41° N.

Occultation of Star by the Moon (visible at Greenwich)

Dec.	Star	Mag.	Disap.	Reap.	Corresponding angles from vertex to right for inverted image
			h. m.	h. m.	° °
28 ...	29 Capricorni ...	6 ...	18 31 ...	19 34 ...	159 307

Dec. h.
27 ... 19 ... Mars in conjunction with and 3° 29′ south of the Moon.

GEOGRAPHICAL NOTES

SEVERAL recent German geographical periodicals refer to a paper read by Prof. Kan, of Amsterdam, before the Section for Geography and Ethnology at the fifty-ninth Congress of German Physicians and Men of Science at Berlin in September, urging on German explorers the necessity of undertaking a geographical and geological exploration of the Moluccas. He said that, although Europeans had settled in the islands for centuries, our knowledge of the orohydrography, especially of the physical features of the archipelago, was exceedingly small. Excellent charts exist in abundance, and travellers, English and German, have subsequently visited it; but they were neither geographers nor geologists, but as a rule studied only the fauna and flora. The Dutch Government has done nothing as yet in reference to the geography of the Moluccas, because it has turned all its energies to procuring good maps of the more extensive Sunda Archipelago. Java has been triangulated and surveyed; there are excellent charts of the coast of Sumatra, and the triangulation of this great island has also been commenced, and, in late years, maps of parts of Celebes and Borneo have been produced. In geology, those islands of the Sunda Archipelago which contain useful minerals have been studied, and excellent geological maps of Sumatra, Banka, Billiton, South-East and North-West Borneo have appeared. In addition, the Government places annually at the disposal of the Geographical Society of Amsterdam 10,000 florins, which, Prof. Kan hoped, would next year be applied to the exploration of the Aru Islands. On the whole, therefore, the Dutch authorities are not lax in surveying and mapping their possessions in the East. Besides the Moluccas, Flores and Timor still offer a virgin field to the explorer, and Prof. Kan hinted that the traveller who undertook the work would not lack pecuniary or other help in Holland.

THE last number of *Petermann's Mitteilungen* contains the conclusion of Lieut. von François's account of his journey in the Southern Congo basin, the present instalment being mainly occupied with climatology and detailed hydrographical observations. Dr. Philippi also concludes the very interesting paper, to which we have already referred, on the changes wrought by man in the flora of Chili. It contains systematic tables of the plants introduced into Chili, and which it now has in common with Europe. Dr. Emil Jung continues his examination of the last census returns of India, the special subject in this number being the effect of the last famine on the movement of the population. There is, further, a brief review of the new edition of Berghaus's "Physical Atlas," and notes on an excellent map of the Dobrudja, which is appended.

WE have also received the last supplementary number (No. 84) of the *Mitteilungen*. It deals with the economical geography of the whole of North America, and is really the first number of a series called *Archiv für Wirtschaftsgeographie*. It treats of agriculture, forestry, mining, industry, trade, shipping, &c.

AT the last meeting of the Paris Geographical Society (November 19), M. Hansen-Blanzsted read a communication on the physical appearance of Denmark in the middle of the eleventh century, as compared with the present time. M. Venukoff referred to the results of M. Nikolsky's studies last year of the physical geography of Asiatic Russia, especially the gradual drying up of Lake Balkash. The level of the lake is lowered by about 1 metre every fourteen or fifteen years. Two letters addressed to the Ministry of Public Instruction by M. Chaffanjon *en route* for the Upper Orinoco, were read, one from Ciudad Bolivar, the second, dated August 18, from Caicara. An interesting communication was read with regard to the last resting-place of Tavernier, the celebrated French traveller, who died in 1689. It was long unknown where he was buried, but it has at last been discovered to be the Protestant cemetery at Moscow. The question of the best method of permanently marking the grave was referred by the Society to a Committee. Capt. Longbois read a humorous account of a journey to Choa, which had for its object the exploration of the Awash and its basin.

THE current number of the *Boletin* of the Madrid Geographical Society contains an interesting account of Don Manuel Iradier's recent explorations in the newly-acquired Spanish territory on the west coast of Africa. The enterprising explorer paid two visits to this region—first in 1875-77, and again in 1884-85, during which he traversed 4000 miles between the equator and 3° N. lat., penetrating from the sea-board into the interior as far as about 20° E. long., and surveying to their sources all the coast streams between the Rio-del-Campo and the Gaboon. By far the largest of these rivers is the Muni, which enters the Atlantic in Corisco Bay, after receiving the contributions of the Utamboni, Noya, and other considerable affluents on both sides, and draining an area of nearly 6000 square miles between the Gaboon and the Rio San Benito. The whole of this river-basin is now Spanish territory, the protectorate having been everywhere accepted by the chiefs of the local tribes, who are collectively known as Vengas, and belong in type and speech to the Bantu family.

THE same *Boletin* reports the arrival in Lisbon of Major Serpa Pinto and Lieut. Augusto Cardoso, leaders of the Portuguese Expedition which has just completed the exploration of the region between Mozambique and Lake Nyassa. Starting from Ibo, south of Cape Delgado, the explorers advanced to the Mutepuezi River, and thence to Medo, where, Serpa Pinto falling ill, Cardoso took the lead. After traversing the Metarica district, the Lienda, an affluent of the Rovuma, was followed for some days, and found not to rise in Lake Nmaramba, but to flow through that lacustrine basin from Mount Songe, further to the west. From this point Lake Nyassa was reached in the Ki-Rassia district, whence the explorers proceeded by the familiar route down the Shiré to the Zambesi, and so on to Quilimane, on the coast. Being provided with excellent instruments, the explorers were able to take a very large number of astronomical and meteorological observations in a region now for the first time systematically surveyed.

THE prospectus has been issued in Vienna of a new geographical periodical to be called *Geographische Abhandlungen*; the editor is Prof. Penck, of the Vienna University, and Herr Hölzel is the publisher. It is not intended to compete with any existing geographical publications, but rather to supplement them. Each number will be complete in itself; compilations will be wholly excluded, and although a certain number will appear in the course of a year, the dates will not be fixed beforehand, in order to leave the writers as unfettered as possible. The three numbers promised are on the glaciation of the Salzach district, the orometry of the Black Forest, and the arrangement or distribution of the Eastern Alps, by Drs. Brückner, Neumann, and Böhm respectively.

ON SOME FURTHER EVIDENCES OF GLACIATION IN THE AUSTRALIAN ALPS[1]

SINCE my announcement of the discovery of glacier evidences in the Mitta Mitta Valley ("On the Meteorology of the Australian Alps," *Trans. Roy. Soc. Vict.*, 1884, p. 23), and Dr. von Lendenfeld's subsequent discovery of traces of ancient glaciers on Mount Kosciusko ("On the Glacial Period in Australia," *Proc. Linn. Soc. N.S.W.*, 1885, p. 45), an interesting controversy has arisen respecting the nature and extent of such glaciation. Having recently undertaken an exploration of Mount Bogong, the highest mountain in Victoria, in company with Dr. von Lendenfeld, for the purpose of discovering further glacier evidences, and so aiding a solution of this important question, I have much pleasure in submitting the following remarks on the results of that expedition. It may be of interest to review my connection with the controversy as a student of physiography resident in the central part of the Australian Alps. During 1880-83, when studying the *flora* of the Australian Alps and collecting herbarium specimens for our venerable Nestor of botanic science, Baron von Mueller, it appeared to me that the date of the introduction of the endemic *florula* of the Australian

[1] Paper read at the Linnean Society of New South Wales, on May 26, 1886, by James Stirling, F.G.S., F.L.S.

Alps (whose affinities were so closely Tasmanian) might safely be centred in glacial movements since Miocene times ("Remarks on Flora of Australian Alps," *Southern Science Record*, 1885, p. 93), provided geological evidences which would lend support to the hypothesis could be obtained; for, as remarked by the ex-President of the Linnean Society, Mr. Wilkinson, F.G.S., F.L.S., in one of his admirable addresses to the Society (President's Address, *Linn. Soc. N.S.W.*, vol. ix., p. 1236), the existence of a semi-tropic flora in South-East Australia during Pliocene times and its subsequent banishment from this region is evidence of a great change of climate in Post-Pliocene times.

In a paper which I have in preparation on the geographic range of the flora of the Australian Alps, it will be shown that many species found there between 2000 and 5000 feet have a wide range, recent researches on the flora of Morocco in Africa, and on that of Kurum Valley, Afghanistan, having disclosed the presence of numerous species of plants common to the Australian Alps; and as Sir Joseph Hooker remarked many years since in his splendid essay on the flora of Australia, "if as complete evidence of such a proportionately cooled state of the intertropical regions were forthcoming as there is of a glacial condition of the temperate zones, it would amply suffice to account for the presence of European and Arctic species in the Antarctic and south temperate regions of both hemispheres on the mountains of intermediate tropical latitudes."

As early as 1882 I discovered many examples of what appeared to be glaciated surfaces in the higher regions of the Australian Alps, notwithstanding that in some areas there were strong evidences of powerful sub-aërial denudation and erosion having taken place during Pleistocene times. *En passant*, I may mention that these apparently glaciated surfaces were seen on the quartz porphyries of Mount Cobboras at elevations between 4000 and 6000 feet; on the metamorphic rocks of Mount Pilot on the Pilot River Valley, down to 3000 feet; and on the granitic rocks of Mount Kosciusko, recently photographed by Dr. von Lendenfeld. Partly, however, from inexperience of glaciated surfaces elsewhere, I hesitated to pronounce authoritatively on them as glacier evidences until further opportunities were afforded me of discovering moraines and erratics at the lower levels. From the fact that my friend, Mr. A. W. Howitt, F.G.S., had not observed any appearances which he could in any way refer to a glacial period analogous with that of the northern hemisphere, unless (as he further remarks) the old lake basins near Omeo might suggest the action of ice ("Geology of North Gippsland," *Q.J.G.S. Lond.*, vol. xxxv. p. 35), I thought it very probable that any pre-existing evidences at the lower levels might have been scoured away by a subsequent pluviatile period ("On a Geological Sketch Section through the Australian Alps," *Trans. Roy. Soc. S.A.*, 1884).

The publication by my friend, Mr. G. S. Griffiths, of a paper on evidences of a glacial epoch in Victoria during Post-Miocene times (*Trans. Roy. Soc. Vict.*, 1884), induced me to re-examine the evidences at the higher altitudes, and to endeavour to follow the traces to lower levels in the Indi and Mitta Mitta Valleys, with the result that I felt justified in making the announcement previously referred to on December 11, 1884, even though some of the phenomena therein ascribed to glacier action might be found on closer scrutiny to have been produced by other causes. The indications taken as a whole were sufficient in my opinion to justify the hypothesis of glaciation, for on no other conceivable theory, as it appeared to me, could the facts as a whole be accounted for; while refrigeration of the area, and the consequent production of glaciers in the valleys of the Australian Alps over wide areas, would harmonise with conclusions deducible from an examination of the flora and fauna. In the beginning of January 1885, Dr. von Lendenfeld ascended Mount Kosciusko and photographed some glaciated surfaces. From the absence of any reference to my previous announcements save a mere reference from the *Southern Science Record* to the snow patches at the higher regions of the Australian Alps, I inferred that Dr. von Lendenfeld was unaware of my previous writings and discoveries, or he would not have stated in his interesting paper "On the Glacial Period in Australia," read before the Linnean Society of N.S.W. during January 1885, that the glacial area was limited to 100 square miles above 5800 feet altitude. On July 9 I published in the *Transactions* of the Royal Society of Victoria the first of an intended series of papers, "On the Evidences of Glaciation in the Australian Alps," detailing certain phenomena in the Livingstone Creek and Victoria River Valleys. During the same month a paper, by Captain, now Professor, Hutton, F.G.S., of New Zealand, was read before the Linnean Society of N.S.W., "On the Supposed Glacial Epoch in Australia," being in part a reply to Dr. von Lendenfeld's previous writings concerning a very recent glacier epoch in the southern hemisphere, based upon New Zealand experiences and explorations, and partly an endeavour to show that the *roches moutonnées* and smoothed surfaces on Mount Kosciusko by no means imply, or, to use the actual words of the learned Professor, "it by no means follows, that they were caused by a glacial epoch, because they might equally well be due to greater elevation, combined with greater atmospheric moisture. We are also advised to "distrust an attempt to explain an *isolated phenomenon* by means of a wide-spread cause." Now it appears to me that Captain Hutton would not have assumed the isolation of the phenomena if he had been fully acquainted with the literature of the subject, and especially my announcement previously referred to. I do not propose to join issue with him in respect to the distinction he seeks to draw between a "glacier epoch" and a "glacial epoch," but merely to show that the phenomena of glaciation are not so isolated as his remarks would lead one to suppose he believes them to be. I am led to make these remarks because as a student of physiography I feel very much indebted to Prof. Hutton for the valuable information supplied by his writings concerning the geological structure, flora, fauna, and climatology of New Zealand, and I should be sorry to know that he laboured under any misapprehension as to the nature and extent of the evidences of glaciation in the Australian Alps. Following the publication of the papers of myself and Prof. Hutton we have one by Prof. Tate, F.G.S., of South Australia ("On Post-Miocene Climate in South Australia," *Trans. Roy. Soc. S.A.*, 1885), read before the Royal Society of that colony, in which are stated very clearly the evidences in favour of a glacial period in South Australia. The objections by Mr. Scoullar, Cor. Mem., as to the origin of the glaciated surfaces near Adelaide, viz. that they were caused "by the attrition of blown sand," are also controverted. I have seen some photographs of these glaciated surfaces (sent to me for inspection by Prof. Tate), and they resemble very strongly the glaciated surfaces on Mounts Cobboras and Bogong, to be hereinafter referred to. Dr. von Lendenfeld has also seen some photographs of polished rocks from South Australia, and has no doubt as to the glacier origin of the polishing ("Note on the Glacial Period in Australia," *Proc. Linn. Soc. N.S.W.*, vol. x. p. 330), although he doubts whether the striæ referred to are isochronal with the glacial traces he discovered on Mount Kosciusko. In consequence of a very interesting correspondence on the subject of glacier evidences between Dr. von Lendenfeld and myself, it was arranged that we should make a joint trip to the highest mountain in Victoria, Mount Bogong, and, if time and circumstances permitted, explore the Bogong High Plains to the south, and proceed thence along the main dividing range towards Mount Kosciusko, so that his extensive European Alpine experience and my local geological knowledge might be utilised, and the features discussed on the ground. On January 3, 1886, we met at Snowy Creek junction, a tributary of the Mitta, and on the following three days made the ascent of Mount Bogong from the north, an arduous journey, but still of great interest. Dr. von Lendenfeld has already described our journey in the publications of the Mining Department of Victoria (Mining Registrar's Returns for Quarter ended March), so that it is unnecessary for me to repeat the narrative. Suffice it to say that the evidences of glaciation discovered by us are:—

(1) Erratics in the Reewa River and Snowy Creek Valleys.

(2) *Blocs perches* and smoothed surfaces on Mount Bogong.

(3) Moraines at base of Mount Bogong, Mountain Creek in Reewa River Valley.

The first-named are abundant in the Pleistocene drifts at Snowy Creek, consisting of huge basaltic boulders, &c., in linear extension for miles, as at Granite Flat; the nearest basaltic outliers being fully twenty miles distant on Bogong High Plains, &c.

The second, or what I have called *blocs perches*, are large semi-rounded or sub-angular masses of igneous or rather plutonic rock—hornblende porphyrites—occupying the crests of spurs and sidelings in a regular descending series from near the summit of Mount Bogong, 6508 feet, towards the Reewa Valley, many of them resting upon smoothed surfaces of pegmatite at lower levels. (Mount Bogong is gneissic.)

The last-named are huge masses of angular and sub-angular

rocks at the base of Mount Bogong, pronounced by Dr. von Lendenfeld to be undoubted moraines (at an elevation of 1000 feet above sea-level). I may remark that these masses are too extensive and distant from the steep spurs of Mount Bogong to be considered as *talus*; besides which they show evidences of translocation.

I do not purpose entering into a description of further evidences discovered by myself in the Mitta Mitta Valley, at Lake Omeo, or Benambia Creek, &c., in the present paper. There will in due course be communicated a second article on the evidences of glaciation in the Australian Alps, together with a reply to later criticisms. I merely desire to show that the evidences discovered on Mount Kosciusko by Dr. von Lendenfeld are by no means isolated, and that the highest mountain in Victoria, Mount Bogong, presents features which confirm the evidences of glaciation elsewhere, and that there is no *a priori* impossibility of the area of glaciation being more extensive than has been assumed. In conclusion, I would add that taking into consideration the facts supplied to us by the examination of the ancient flora and fauna of Australia as contained in the writings of Prof. Tate, of South Australia, and of Mr. Wilkinson, F.G.S., of New South Wales, and the geological evidences of glaciation over widespread areas daily accumulating, it is difficult indeed to resist the conviction that Southern Australia, as well as South America and Southern Africa, and indeed New Zealand, all participated in a period of refrigeration, culminating in an ice-clad region during later Pliocene or Pleistocene times, notwithstanding that many difficulties suggest themselves in endeavouring to work out the problem from mere localised observations.

SORGHUM SUGAR

SOME months ago considerable interest was excited by a report by Mr. Victor Drummond on the production of sugar from sorghum and maize. The report was sent from the Colonial Office to Mr. Thiselton Dyer, with a request that he would state his opinion on the questions raised by Mr. Drummond. For several years the importance of the subject had been recognised at Kew; and in his reply, dated August 10, 1886, Mr. Thiselton Dyer expressed his belief that if sugar could be produced at a cheap rate from sorghum and maize it would entirely take the place of cane and beet sugar, the geographical range of sorghum being far more extensive than that of the sugar-cane proper or of the beet. At the same time he drew attention to the fact that the results summarised by Mr. Drummond had been for the most part derived from laboratory experiments only, and that the question whether the new industry was likely to prosper could not be determined until those results had been tested over wide areas. He also pointed out that some statements in Mr. Drummond's report were at variance with well-known facts in vegetable physiology. Mr. Thiselton Dyer therefore advised that exact information as to the position of the sorghum- and maize-sugar industry in the United States should be obtained through the Foreign Office.

In accordance with this advice, copies of Mr. Drummond's report and Mr. Thiselton Dyer's letter were sent to Sir L. West. By him the matter was put into the hands of Mr. C. Hardinge; and now Mr. Hardinge's report has been published in the series of Foreign Office "Reports on Subjects of General and Commercial Interest." The sorghum-sugar industry has hitherto been conducted on a small scale. In 1884 it was carried on at eight factories, which produced 1,000,000 lbs. in all. The comparative insignificance of this result will be seen when it is stated that in 1885 the quantity of cane-sugar consumed in the United States was 1,170,000 tons. In most cases it was found that the cost of extracting sugar from sorghum exceeded receipts, and at the present time the industry is prosecuted at only two factories —that of the Rio Grande Company and that of the Franklin Sugar Company, whose works have been removed from Ottawa to Fort Scott.

Dr. Wiley, by whom the subject has been thoroughly investigated, attributes the failure of the industry, so far, chiefly to the following causes:—

(1) The difficulties inherent in the plant have been constantly under-valued. By taking the mean of several seasons as a basis of computation, it can now be said that the juices of sorghum, as they come from the mill, do not contain over 10 per cent. of sucrose, while the percentage of other solids in solution is at least 4, thus rendering the working of such a juice one of extreme difficulty.

(2) The chemistry of the process is at present hardly known, and great development is necessary in this direction.

(3) The area of land where the climate and soil are best adapted for the cultivation of sorghum is not nearly so extensive as was at first imagined, and investigation should be made in order to discover in which localities the necessary conditions are most favourable.

(4) Commercial depression and the consequent low prices have affected this industry, and caused failure and losses in cases where all other conditions were favourable.

(5) Lastly, the mechanical treatment of the juice is very imperfect, the machinery used in the mills being quite inefficient for the purposes intended.

In order that the last-mentioned defect might be corrected, the Commissioner of Agriculture decided that experiments for the application of the process of diffusion on a practical scale should be carried on with the best machinery possible, and the direction of the experiments was intrusted to Dr. Wiley. He erected the battery and necessary buildings in connection with the works of the Franklin Sugar Company at Ottawa, Kansas, and the first trial of the process of diffusion was made on October 8, 1885. The general results of the experiments of 1885 show that:—

(1) By the process of diffusion 98 per cent. of the sugar in the cane was extracted, and the yield was fully double that obtained in the ordinary way.

(2) The difficulties to be overcome in the application of diffusion are purely mechanical, and by enlarging the diffusion-cells to a capacity of 130 cubic feet, and by making a few changes in the apparatus, it would be possible to work 120 tons per diem.

(3) The process of carbonatation for the purification of the juice is the only method which will give a limpid juice with a minimum of waste and a maximum of purity.

(4) By a proper combination of diffusion and carbonatation, 95 per cent. of the sugar in the cane can be placed on the market, either as dry sugar or molasses.

When his experiments were ended, Dr. Wiley was instructed by the Commissioner of Agriculture to proceed to Europe for the purpose of inspecting and purchasing such forms of machinery as might appear most useful, also to gain such information as might secure the greatest success in this work; and Mr. Hardinge reports that much useful information, chiefly of a mechanical nature, was obtained by Dr. Wiley during the course of his visits to several of the most important sugar factories in France, Germany, and Spain.

During the season of 1886 further experiments have been carried on at Fort Scott, under the direction of the Department of Agriculture, and the results have not proved to be as satisfactory as was anticipated.

ON THE CUTTING OF POLARISING PRISMS[1]

THE author showed the manner of cutting two new polarising prisms, designed by Ahrens and by himself, and described and figured in the *Phil. Mag.* for June 1886. The Ahrens polariser is a rectangular parallelopipedon of calc-spar having square end-faces, and having its long sides in the proportion of about 1·6 : 1 relatively to the short sides. The square end-faces are principal planes of section of the crystal. Two oblique sections are cut in the prism, being carried through the top and bottom edges of one end-face, and meeting in the horizontal middle line of the others. The dihedral angle between these planes of section is about 32°. The faces are polished and reunited with Canada balsam in the usual way. The advantages claimed for the new prism are: (1) decrease in length, (2) increase in angular aperture, (3) saving of light consequent on non-obliquity of end-faces, (4) minimum of distortion, (5) less spar required than in Hartnack, Glan, or Thompson prisms of same section. Against this are the slight disadvantages of (1) the line of section across end-face, and (2) the use of more spar than a Nicol of equal section. But Mr. Ahrens has recently added a thin covering-glass at the end-face crossed by the line of section, thereby making this line almost imperceptible; and he has also succeeded in finding a new method of cutting the prism in which there is extremely little waste of spar. The other prism designed by the author is a simple modification of the Nicol, giving a wider angle of field. A wedge is cut off

[1] Abstract of a Paper read at the Birmingham meeting, 1886, of the British Association, by Prof. Silvanus P. Thompson.

each end of the calc crystal so as to make the new end-faces almost co-planar with a principal plane of section, and the crystal is cut through along the other diagonal of the sides. The results may be tabulated thus :—

	Ordinary Nicol	Reversed shortened Nicol
Obliquity of end-face	71° ...	69°
Angle between end-face and crystallographic axis	45 ...	5
Angle between balsam-film and crystallographic axis	45 ...	94

The effect is to throw the blue-iris limit right back, to shorten the prism, and to widen the field. In the discussion that followed, Prof. Stokes remarked that there was no dearth of Iceland spar in Iceland, but that the supply had been limited through ignorance of the extent of the demand. The mine had, however, been bought by the Icelandic Government, and a plentiful supply might therefore be expected.

THE SYMPATHETIC NERVOUS SYSTEM[1]

THE lecturer commenced by giving a short sketch of Bichat's views of the division of life into organic and animal life, and pointed out how that division naturally led to the conception of two separate central nervous systems, the one, the sympathetic, to which all the organic functions are to be referred, the other, the cerebro-spinal, regulating the animal functions. He then pointed out how Remak's discovery of a special kind of nerve-fibre—the non-medullated nerves—associated only with the ganglia of the sympathetic system, tended strongly to confirm Bichat's teaching of the existence of two separate central nervous systems in the human body, each of which communicated with the other by means of its own special kind of nerve-fibres ; the cerebro-spinal supplying the sympathetic system with white medullated fibres, and the sympathetic supplying the cerebro-spinal with gray or gelatinous non-medullated fibres. He then continued as follows :—

Even at the present day the teaching of Bichat still very largely holds its ground. It is true that the tendency of modern physiology is to increase the number of centres of action for the organic nerves, which exist in the cerebro-spinal central axis, and therefore to do away with the necessity for a separate independent sympathetic nervous system, yet the automatic actions of isolated organs such as the heart, and the existence of special nerve-fibres in connection with this system, still induce the neurologists of the present day to place the sympathetic nervous system on an equality with the brain or spinal cord. In this lecture to-night I hope to give the death-blow to Bichat's teaching, and to prove to you that the whole sympathetic system is nothing more than an outflow of visceral nerves from certain nerve-centres in the cerebro-spinal system, the ganglia of which are not confined to one fixed position, as is the case with the ganglia of the posterior roots, but have travelled further away from the central axis.

I do not propose to-night to deal with the argument for the independence of the sympathetic nervous system, which is based upon the automatism of such isolated organs as the heart ; I have already in various papers given the reasons and arguments why I look upon such automatic movements as due to the automatism of the cardiac muscular tissue rather than to any action of nerve-cells comparable to the nerve-centres of the spinal cord ; I shall deal entirely with the anatomical argument, and show you step by step how the nerve-fibres which constitute the sympathetic system can be traced to their origin in the central cerebro spinal axis.

Evidently, in endeavouring to determine by anatomical means whether the sympathetic and cerebro-spinal systems are in reality independent of one another, our attention must necessarily be especially concentrated upon the nature of the connecting-link between the two systems, *i.e.* upon the nature of the rami communicantes. Largely owing to the pre-conceived notions of anatomists, you will find that the rami communicantes are arranged symmetrically in connection with all the spinal nerves of the body. In reality this is far from being the case ; the rami communicantes of the thoracic nerves differ from those above them, *i.e.* of the cervical nerves, and from those below them, *i.e.* of the lumbar nerves, in two important particulars : in the first place the corresponding sympathetic ganglion is connected with each thoracic nerve by two rami communicantes ; and secondly, these two rami differ in colour, one being gray, *i.e.* composed almost entirely of non-medullated nerves, and the other white, *i.e.* composed essentially of medullated nerve-fibres.

This double nature of the ramus communicans is confined to the region lying between the two large plexuses which supply the anterior and posterior extremities, viz. the brachial, lumbar, and sciatic plexuses ; the rami communicantes to the lower cervical and first thoracic nerves, as well as those to the nerves forming the anterior crural and the sciatic, are, on the other hand, single, and are composed only of gray rami. In other words, the sympathetic chain is connected with the central nervous system by means of white rami communicantes only between the second thoracic and second lumbar nerves.

Further, I have been able to trace both the white and gray rami in their journey to the spinal cord by means of consecutive sections of osmic acid preparations, and have found that the gray rami pass out of the sympathetic ganglion as a single nerve, and then ramify in the connective tissue about the vertebral foramina, a portion only reaching the spinal nerve-trunk ; the gray fibres of this portion pass mainly along the nerve peripherally, the few which pass centrally never reach the spinal cord, but pass out with the connective tissue which lies in between the medullated nerve-fibres of the anterior and posterior roots, to ramify over and to supply the blood-vessels of the various membranes which inclose the spinal cord.

In fact the gray rami communicantes are peripheral nerves, which partly supply the vertebræ and the membranes of the cord, and partly pass to their destination in the same direction as the efferent fibres of the spinal nerve itself.

So far then I come to these conclusions :—

(1) The sympathetic does not send non-medullated fibres into the cerebro-spinal system, because these fibres all pass out of the nerve-roots before they reach the spinal cord.

(2) White or medullated nerve-fibres constitute the only link between the sympathetic and cerebro-spinal systems, constituting the white rami communicantes.

(3) Consequently the connection between these two nervous systems is limited to the region of white rami communicantes, *i.e.* to the region between the second thoracic and second lumbar nerves.

Further, these conclusions are borne out when we attempt to follow the white rami commnnicantes into the central spinal axis by means of their structural peculiarities ; sections of osmic preparations show that each white ramus is composed chiefly of very small medullated nerve-fibres, varying in size from 1·8 μ to 3·6 μ, very much smaller, therefore, than the large medullated nerves which form the bulk of the anterior roots of the spinal nerves, these latter varying between 14 μ to 20 μ or even larger. Clearly then the fibres of the white ramus communicans ought to show very conspicuously among the large fibres of the anterior roots whenever they are present in those roots. I have cut sections of the anterior roots of all the spinal nerves in the dog, and have found, as I show you on this screen, that these very fine medullated nerve-fibres make their appearance for the first time in the anterior roots of the second thoracic nerve ; they are found in large quantities in all the anterior roots between the second thoracic and second lumbar, and then again the anterior roots immediately below the second lumbar are free from such groups of very fine fibres. We see then that exactly corresponding to the presence of white rami communicantes in the thoracic region we find groups of characteristic fine medullated fibres existing in the anterior roots, fibres which clearly form part of the white ramus communicans, and confirm by their presence the conclusion already arrived at, viz. that the nerves which pass from the spinal cord into the sympathetic system are limited to the thoracic region of the cord.

We can now go a step further and argue in the reverse direction that the presence of groups of these very fine medullated fibres in the anterior roots of any nerve implies the existence of nerve-fibres belonging to the same system as the white rami communicantes or rami viscerales, as we may now call them. Examination shows how just is this argument, for I find that the same groups of fine nerve-fibres suddenly appear again in the anterior roots of the second and third sacral nerves, and can be traced into that well-known nerve which passes from the second and third sacral nerves into the hypogastric plexus to

[1] Abstract of Lecture at the Royal Institution on June 4, 1886, by Walter H. Gaskell, M.D., M.A., F.R.S.

supply the rectum, bladder, and reproductive organs; a nerve, therefore, which may be looked upon as the white ramus communicans of the sympathetic ganglia which form the hypogastric plexus.

Again, in the cervical region, although such groups of fine fibres are absent from the anterior roots of all the cervical nerves, yet they form a conspicuous part of the upper roots of the spinal accessory nerve, and upon tracing them outwards I find that they separate entirely from the large fibres of the accessory which form its external branch to pass as the internal branch into the ganglion trunci vagi (Fig. 2). Here, then, we see in the upper cervical region that the internal branch of the spinal accessory nerve is formed on the same plan as a white ramus communicans, the ganglion belonging to which is the ganglion trunci vagi.

Among the cranial nerves we find, especially in the vagus, glosso-pharyngeal, and chorda tympani, groups of fine nerve-fibres belonging to the same system. We can therefore say that the communication between the so-called sympathetic and cerebro-spinal systems is not symmetrical throughout, but consists of three distinct outflows of characteristic visceral nerves, viz.: (1) cervico-cranial; (2) thoracic; (3) sacral; the break of continuity corresponding to the exit of the nerve plexuses which supply the upper and lower extremities.

These medullated visceral nerves then pass out from the central nervous system into the various ganglia of the sympathetic, and it is possible that these latter ganglia bear the same kind of relation to them as the ganglia on the posterior roots bear to the sensory nerves. Before, however, we can accept this view, it is absolutely necessary to account for the non-medullated nerves which arise from the sympathetic ganglia. Now it is hopeless to follow, by anatomical means, any special nerve-fibre through the confusion of a ganglion. What we cannot effect by anatomical methods we can by physiological. If we find two nerves, one of which enters a ganglion and the other leaves it, and we find their function absolutely the same on both sides of the ganglion, we have a perfect right to conclude that we are dealing with the same nerve in different parts of its course. Thus, in the case of the posterior root ganglion, the same sensory nerves are found on each side of the ganglion, although they are in connection with nerve-cells of the ganglion itself.

So also with the sympathetic ganglia: we know, for instance, that the nerves which increase the rate and strength of the heart's beat pass to the ganglion stellatum along the rami communicantes of the second and following thoracic nerves, and we know also that the same nerves pass to the heart from the ganglion stellatum, from the annulus of Vieussens, and from the inferior cervical ganglion. Now, seeing that these nerves are known to pass out of the cord in anterior roots, and from thence into the white rami communicantes of the upper thoracic nerves, it follows that they are medullated in this part of their course, and are to be found among the bundles of very fine medullated nerves which we have seen are characteristic of the anterior roots of this region and of the white rami communicantes.

We can then say with certainty that the accelerator nerves enter the ganglia stellata as fine white medullated nerves. I am also able to say with absolute certainty that the accelerator nerves in that part of their course which lies between the chain of sympathetic ganglia and the heart are entirely composed of

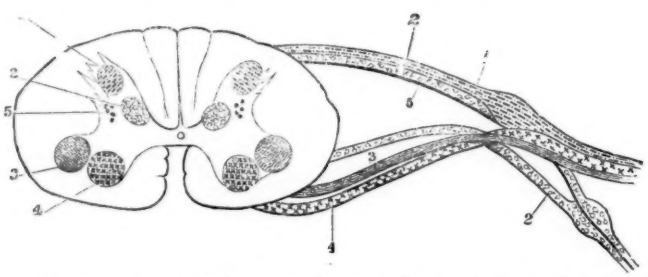


FIG. 1.—Diagram of section of spinal cord to show the various groups of nerve-cells in the gray matter, and the formation of a spinal nerve with its sympathetic ganglion. 1, cells of posterior horn and somatic sensory nerves. 2, cells of Clarke's column and ganglionated splanchnic nerves. 3, cells of lateral horn and non-ganglionated splanchnic nerves. 4, cells of anterior horn and somatic motor nerves. 5, solitary cells of posterior horn and splanchnic sensory nerves.

non-medullated fibres. I know no other bundle of nerve-fibres which is so absolutely free from medullated nerves: in other words, nerve-fibres of the same function enter a sympathetic ganglion as white medullated fibres, and leave it in increased numbers as gray non-medullated nerves.

Throughout we find the same fact—all the vasomotor nerves behave in exactly the same manner as the accelerators of the heart. In all cases the non-medullated fibres of the sympathetic are simply the fine medullated visceral nerves which have passed from the spinal cord in one or other of the three visceral outflows and lost their medullary sheath in their passage through the ganglia of the sympathetic system; together with that loss of medulla they have increased in number by division.

Seeing, then, that the non-medullated (so-called sympathetic) nerve-fibres are throughout modified medullated (so-called cerebro-spinal) fibres, and do not, therefore, arise in the sympathetic ganglia, we may fairly look upon the sympathetic ganglia as bearing the same kind of relation to the visceral nerves that the ganglia of the posterior roots bear to the ordinary sensory nerves. This conception is remarkably confirmed by the observations of Onodi, who has shown that the ganglia of the sympathetic are developed in close connection with the posterior root ganglia, and travel further away from the central axis as the animal grows.

Finally, the meaning of the sympathethic as a simple outflow of ganglionated visceral nerves from certain portions of the spinal cord and medulla oblongata is, to my mind, conclusively settled by the intimate relationship which exists between the structure of the spinal cord and the presence or absence of rami viscerales. In the gray matter of the spinal cord we find, as shown in the accompanying diagram, certain well-defined groups of nerve-cells, viz., *a*, a group of large nerve-cells in the anterior horn (4 in Fig. 1); these are known to be the origin of ordinary motor-fibres (4); *b*, a group of nerve-cells (3) split off from this and forming the lateral horn; *c*, a group (2) known as Clarke's column; and *d* and *e*, two sets of nerve-cells, (4) and (5), in the posterior horn connected with sensory nerves. All these groups of nerve-cells are found along the whole length of the spinal cord, except those of Clarke's column. Their connection with nerve-fibres of different functions is known, except those of Clarke's column. Thus both sets in the anterior horn are connected with ordinary motor-nerves; both sets in the posterior horn with ordinary sensory nerves. Now, Clarke's column is limited to certain definite regions of the cord, being conspicuous: firstly, between the second thoracic and second lumbar nerves; secondly, at the top of the cervical region and extending into the cranial region; and, thirdly, an isolated patch in the sacral region. In other words, its cells correspond exactly in position to the distribution of the white rami communicantes, so that, corresponding to the variation of this cell-group, we find variations of the number of very fine medullated fibres in the anterior roots, and we find corre-ponding variations in the white rami communicantes, which latter, as I have told you, are the only true connections of the cerebro-spinal nerve-centre with the sympathetic. In other words, we have driven home to their origin these visceral nerve-fibres, and we find that they do not arise from any nerve-cells outside the brain and spinal cord, but from a definite nerve-group within the spinal cord.

We can, I think, go further than this, and say, with Bichat,

that two nerve-systems do exist—the one for organic, and the other for animal, life. These two, however, are not separate and distinct, but form parts of the same central nervous system. Looking at this diagram of the upper cervical region of the cord, we see that the voluntary striped muscles may be divided into two groups, according to their nerve-supply, viz. a group supplied by the anterior (4), and one by the lateral horn of nerve-cells (3), and we know also that these two groups of nerve-cells separate from one another more and more as we pass into the brain region. So that we find for the muscles of the face a distinct separation of two groups, viz. (1) those which move the eyes and the tongue—these are supplied by nerves which arise from the continuation of the anterior horns; and (2) the muscles of expression and mastication, the nerves of which arise from the continuation of the lateral horn; and remembering how the smile, the laugh, and the snarl, as well as the action of swallow-

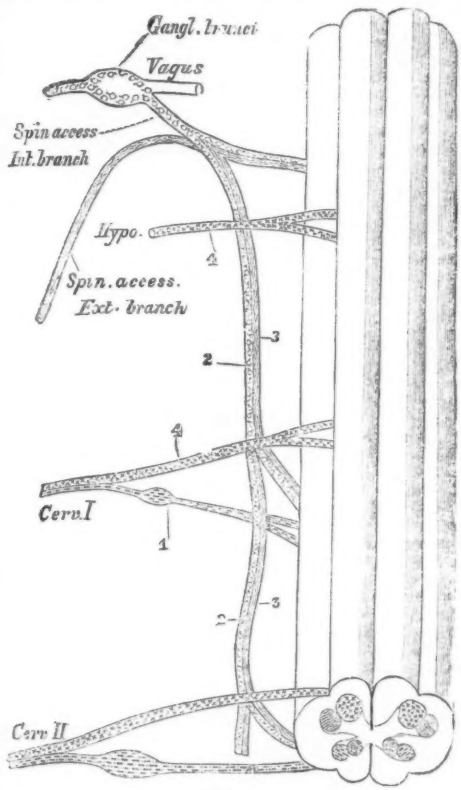


FIG. 2.

ing, are at the bottom only modified respiratory movements, we see that Charles Bell was not so far wrong when he inserted a lateral or respiratory system of nerves in between the anterior and posterior roots. This insertion is actually to be seen at the upper part of the cervical cord (Fig. 2) where a separate nerve is formed by elements which arise laterally, known as the spinal accessory; and what is most striking is this fact, that in this region the fine medullated fibres (2 in Fig.) are found only in connection with these lateral motor nerves, and not with the anterior motor, so that not only do these lateral or respiratory tracts supply special muscles with motor nerves, but these motor nerves have a closer relationship to the visceral nerves than other motor nerves. What is true of the upper cervical region is true also of the medulla oblongata. Here, again, the visceral fine medullated nerves are closely connected with the motor fibres which arise from the lateral horn, *e.g.* the chorda tympani and the facial. Undoubtedly this particular group of muscles has some closer relationship to the viscera than other trunk muscles, and that relationship is explained immediately if we can accept and extend van Wijhe's investigations, viz. that in the cranial region the muscles which are supplied by the third, fourth, sixth, and twelfth cranial nerves are derived from the myotomes, while the muscles supplied by the seventh and fifth cranial nerves are derived from the lateral plates of mesoblast.

In fact we may look upon the body as composed of two parts—an outside or somatic part, and an inside or splanchnic part. Each part has its own system of voluntary muscles; each part is supplied by nerves arranged on the same plan, viz. a ganglionated and non-ganglionated portion; and each part has its own individual centres of action, the inside portion of the gray matter of the spinal cord containing the centres for the splanchnic roots (2, 3, 5, in Fig. 1), *i.e.* the centres of organic life; the outlying horns the centres for the somatic roots (1 and 4), *i.e.* centres for the animal life. It is a strange and suggestive fact that these two sets of centres are not arranged symmetrically along the spinal axis, but that two great breaks occur in which the centres of organic life fall into the background in comparison to those of animal life. These two great breaks correspond to the origin of the nerves for the legs and arms, and suggest that the formation of the limbs in the originally symmetrical ancestor of the Vertebrata—*i.e.* the large outgrowth of somatic elements in two definite portions of the body—caused of necessity a corresponding increase in the centres for animal life, while there was no necessity for a corresponding increase in the centres for organic life. The oldest part of us is undoubtedly the vital part; those organs and their nervous system by which the mere act of existence is carried on. With these two there may have been originally a symmetrically segmental arrangement of locomotor organs. Such symmetry, however, went for good when it was found more convenient to concentrate the locomotor machinery into the anterior and posterior extremities, and with the asymmetrical arrangement of the locomotor organs disappeared also the symmetry of the central nervous system. This correspondence between the plan of the central nervous system and the development of the extremities is, to my mind, strongly in favour of the view which I have put before you to-night. In conclusion, I thank you for the kindness with which you have listened to me, and hope that I have succeeded in convincing you that Bichat's teaching of an independent sympathetic system is finally dead.

SCIENTIFIC SERIALS

Revue d'Anthropologie, troisième série, tome 1, 1886, Paris.—On the colour of the eyes and hair in different parts of France, by M. Topinard. This paper will form the introduction to a comprehensive work, in which the author proposes to consider the various methods followed in other countries in collecting the necessary data for determining the racial significance of these physical characteristics. In France, where good charts of stature have been drawn up for the several departments, no statistical observations have been made in regard to the colour of the skin, eyes, and hair. This M. Topinard considers at length, both in its significance as a racial characteristic, and in regard to the modifications which it undergoes at various ages, and from different local surroundings. In considering the more or less typical series of colour, the writer draws attention to the extreme rarity in Europe of greenish eyes. In Germany, Prof. Virchow states that, among 6,000,000 persons, green eyes were noted only in six cases. Chinese annals record, however, that green eyes are met with in parts of Asia; and Pallas notes a similar fact in regard to Siberia. In concluding his exhaustive *résumé* of what has been done in other countries, M. Topinard states that he has addressed letters to the members of the French Association for the Promotion of Science, begging their co-operation in the collection of the necessary data for drawing up statistical tables of the relative proportion of the different shades of colour of the eyes and hair in various parts of France.—Illyrian anthropology, by Dr. R. Zampa. The author, who is well known for his able contributions to the ethnography of Italy, has turned his attention to the anthropological character of the Illyrian races, who occupied the South Danubian and other eastern trans-Alpine lands, to which tradition points as the original home of the earliest settlers of the Adriatic provinces of central and lower Italy. Dr. Zampa denies that the Illyrians were ever a homogeneous race, and he points out that while those of the north retained through the ages the character of

savage marauders and pirates, the South Illyrians, four centuries B.C., had been thoroughly amalgamated with the Macedonian and Epirote nations, adopting the pre-Hellenic form of speech of those peoples, which still lingers in the spoken tongue of the modern Albanians. After the incursions of Finns and Slavs into the Balkan and Danube territories, in the sixth and seventh centuries, the remnant of Illyrian and other primitive races that escaped extermination were comprised under the general name of Albanians; and Dr. Zampa believes that in the mountainous districts of Scutari we find the purest representatives of the ancient Albanian race. In this region, therefore, he has sought the data necessary for the elaboration of the comparative anthropological researches of the ethnic relations and differences existing between the Italian and other branches of the Albanian peoples. The author gives at length the results of his measurements of several series of crania obtained in Dalmatia, comparing them with those taken from living subjects; and although it cannot be said that his researches decide the question whence the Albanian Italians derive their origin, they throw important light on the early history of the primitive races of the Balkan Peninsula, and on their gradual amalgamation with the numerous invaders and alien settlers who, in the course of ages, have occupied the lands of the ancient Illyrians.—On trephining, as practised in Montenegro, by M. Védrènes. The question of prehistoric trepanning, which first excited attention about ten years ago, has led to the consideration of the hitherto almost unnoticed fact that cranial trephining has been practised in Europe from the most remote ages to the present day. Indeed, according to M. Védrènes, the operation is also of frequent occurrence among the natives of Aurès, in Algiers, where it is held in high esteem as being both safe and beneficial. Here it is generally used to arrest the acute pains which are frequently experienced after severe injuries to the head; a portion of bone, about a centimetre in diameter, being cut out to admit of the introduction of a sponge for the removal of extravasated blood. A precisely similar operation is common in Montenegro, where, as at Aurès, it is performed by the members of certain families, amongst whom the profession of trephining has flourished for ages, and been respected as an hereditary distinction transmissible from father to son. The author draws attention to the curious circumstance that the practice of trephining and implicit faith in its efficacy have kept their ground, not merely in the semi-barbarous populations of Algiers and the Balkan mountain districts, but even among the miners of Cornwall, who have continued, to our own times, to regard this operation as the only adequate mode of treatment in various injuries to the head.—Contribution to the history of anomalies of the muscles, by M. Ledouble. The author considers that, while the pyramidalis abdomilis, peroneus, palmaris, plantaris, and psoas parvus are more usually absent than any of the other muscles, the last-named is so frequently missing, that some writers have even assumed that its presence was abnormal. It is more frequent in women than in men; but for this peculiarity, as well as for the variations observable in the mode of insertion of psoas magnus and parvus, the author does not attempt to offer any explanation; his paper giving simply the result of his own observations of muscular anomalies in the lower animals, as well as in man.

SOCIETIES AND ACADEMIES

LONDON

Royal Society, November 25.—"On Jacobi's Figure of Equilibrium for a Rotating Mass of Fluid." By G. H. Darwin, M.A., LL.D., F.R.S., Fellow of Trinity College, and Plumian Professor in the University of Cambridge.

Jacobi was the first to prove that a mass of fluid in the form of an ellipsoid, with three unequal axes, is in equilibrium when rotating about the smallest of the three axes. The determination of the axes in terms of the angular velocity of the system has hitherto been left in an analytical form, not well adapted for numerical calculation. In the present paper the formulæ are brought into a shape involving elliptic integrals, and, by the aid of Legendre's tables, a table of solutions is calculated.

If σ be the density of the fluid, ω the angular velocity, and $\frac{4}{3}\pi\sigma$ the mass, then, when $\omega^2/4\pi\sigma = \cdot09356$, the Jacobian ellipsoid is a revolutional figure with axes 1·1972, 1·1972, 0·6977. For smaller values of the angular velocity the first axis increases and the two latter diminish. For example, when $\omega^2/4\pi\sigma = \cdot07047$, the axes are 1·899, 0·811, 0·694.

When the angular velocity is infinitely slow, the ellipsoid becomes infinitely long and thin, and tends to assume a figure of revolution about its greatest axis.

Although the angular velocity diminishes as the length of the ellipsoid increases, yet the moment of momentum continually increases, and becomes infinitely great when the ellipsoid is infinitely long.

The kinetic energy at first increases with the length, attains a maximum, and then diminishes, so that when the ellipsoid is infinitely long it vanishes.

The intrinsic energy, however, always increases, so that the total energy of the system has no maximum, and continually increases with the length of the ellipsoid.

Approximate formulæ are given, which assume a very succinct form when the ellipsoids are long.

December 9.—"A New Method for the Quantitative Estimation of the Micro-organisms present in the Atmosphere." By Percy F. Frankland, Ph.D., B.Sc. (Lond.), F.C.S., F.I.C., Assoc. Roy. Sch. of Mines.

The author commences by describing some of the more important methods which have been elaborated for the bacterioscopic examination of air. In these he includes the experiments of Pasteur, Tyndall, Freudenreich and Miquel, Koch, and Hesse. After pointing out the several advantages and disadvantages which attend these processes, he describes a new method which he has devised, in which he has endeavoured to overcome some of the objections to which the others are open. The following is a brief description of the author's method:—

A known volume of air is aspirated through a glass tube containing two sterile plugs, consisting either of glass-wool alone, glass-wool and fine glass-powder, glass-wool coated with sugar, or sugared glass-wool and fine sugar-powder. The plugs are so arranged that the first one through which the air is drawn is more pervious than the second. After a given volume of air has been aspirated, the two plugs are transferred respectively to two flasks, each containing melted sterile gelatine-peptone, which are then plugged with sterile cotton-wool stoppers. The plug is then carefully agitated with the gelatine until it has become completely disintegrated, care being taken to avoid any frothing of the gelatine; and the latter is then slowly congealed so as to form an even film over the interior surface of the flask.

On incubating these flasks at a temperature of 22° C., in the course of from four to five days the colonies derived from the organisms contained in the plugs make their appearance, and can be readily counted and further examined. A very large number of experiments are recorded which were made to test the accuracy of the "flask-method." For this purpose experiments were made, in which sometimes single, and sometimes double plugs were employed, and it was almost invariably found that all the organisms were deposited on the first plug; the second plug, in the very exceptional cases when it did yield anything, rarely gave rise to more than a single colony.

It was also found that, whereas in out-of-door experiments a *blank* Hesse-tube, exposed side by side with the one through which air was being aspirated, contained a number of organisms,—thus creating an important source of error in the quantitative results obtained by Hesse's method,—in the "flask-method" such blank tubes rarely contained any organisms; and even when such was the case, but a very small proportion of those present in the actual tube.

This shows that, whereas in Hesse's apparatus any disturbance of the air during the experiment vitiates the accuracy of the result, in the "flask-method" no such effect is produced.

On the other hand, in the absence of aërial currents, the blank Hesse-tube contained only a few organisms, and a remarkable uniformity was found in the results obtained by Hesse's method and that of the author. This is important, not only as showing the quantitative accuracy of the "flask-method," but in clearly demonstrating that the organisms present in the air exist in an *isolated* condition, and not in aggregates, as suggested by Hesse, for it will be remembered that the plug is violently agitated with the gelatine-peptone in the flask, during which operation such aggregates would undoubtedly be broken up wholly or at least partially. It would therefore be reasonable to expect that the "flask-method" would yield a larger number, and possibly a far larger number, of colonies than found in Hesse's tubes; but since, on the contrary, the numbers agreed under the circumstances described in so striking a manner, it is shown convincingly that they exist in an isolated condition.

The paper is illustrated by photographs and drawings.

Of the numerous experiments recorded in the paper, the following series made at St. Paul's may be specially referred to, both as illustrating the quantitative accuracy of the process, as well as showing how it may be employed in ascertaining the distribution of micro-organisms in the atmosphere :—

November 19, 1886		Number of micro-organisms found in 10 litres of air
St. Paul's Churchyard		47
Stone Gallery	No. 1	40
	No. 2	35
Golden Gallery	No. 1	10
	No. 2	11
	No. 3	11

The following are the principal advantages which the author claims for the "flask-method" :—

(1) The process possesses all the well-known advantages attaching to the use of a solid cultivating medium.

(2) The results, as tested by the comparison of parallel experiments, can lay claim to a high degree of quantitative accuracy.

(3) The results, as tested by control experiments, are not appreciably affected by aërial currents, which prove such a disturbing factor in the results obtained by some other methods.

(4) The collection of an adequate sample of air occupies a very short space of time, so that a much larger volume of air can be conveniently operated upon than is the case with Hesse's method. Thus, whilst the aspiration of 10 litres of air through Hesse's apparatus takes about three-quarters of an hour, by the new method about 48 litres can be drawn through the tube in the same time ; whilst a better plan is to take two tubes and alternately draw a definite volume of air through each, as by this means duplicate results are obtained.

(5) As the whole plug upon which the organisms from a given volume of air are deposited is submitted to cultivation without subdivision, no error is introduced through the multiplication of results obtained from aliquot parts, and all the great difficulties attending equal subdivision are avoided.

(6) The risk of aërial contamination in the process of *flask-cultivation* is practically *nil*.

(7) The apparatus required being very simple and highly portable, the method is admirably adapted for the performance of experiments at a distance from home, and in the absence of special laboratory appliances.

"Further Experiments on the Distribution of Micro-organisms in Air (by Hesse's method)." By Percy F. Frankland, Ph.D., B.Sc., F.C.S., F.I.C., and T. G. Hart, A.R.S.M.

The authors record a number of experiments, made with Hesse's apparatus, on the prevalence of micro-organisms in the atmosphere. The results are intended to form a supplement to those already obtained by one of the authors, and published in the last number of the Society's *Proceedings*. The greater number of the experiments have been performed on the roof of the Science Schools, South Kensington, the air of which has now been under observation at frequent intervals during the present year. The authors point out the variations, according to season, which have taken place in the number of micro-organisms present in the air collected in the above place. The average results obtained were as follows :—

1886	Average number of micro-organisms found in 10 litres of air by Hesse's method
January	4
March	26
May	31
June	54
July	63
August	105
September	43
October	35

Experiments are also recorded showing the enormous increase in the number of micro-organisms present in the air of rooms consequent on crowding. In illustration of this point the authors cite a series of experiments made in the library of the Royal Society during the evening of the *conversazione* in June last, when the following results were obtained :—

Royal Society's Library	Number of micro-organisms found in 10 litres of air
June 9, 1886, 9.20 p.m.	326
,, 10.5 ,,	432
June 10, 1886, 10.15 a.m.	130

In addition to determining the number of organisms present in a given volume of air, the authors have also, in each case, roughly estimated the number falling on a given horizontal surface by exposing dishes filled with nutrient gelatine and of known superficial area, as in the experiments previously published.

Society of Antiquaries, December 9.—Dr. John Evans, President, in the chair.—Mr. J. Allen Brown, F.G.S., F.R.G.S., read a paper on his discovery of a Palæolithic workshop floor of the Drift period near Ealing. He pointed out that the discovery of this Palæolithic working site fully confirmed his previous observations of the higher river-drift deposits in North-West Middlesex, *i.e.* that such old floors or former land surfaces are often discernible therein, and that such habitable spots have been preserved in different parts of the Thames Valley, though they have frequently been disturbed, removed, and re-deposited in other places by the changing course and curves of the wider river of the past, and by floods and other conditions of the severer climate which then prevailed. This Palæolithic workshop floor, which is about 100 feet above the present bed of the Thames, and about two miles distant from it, is situated near the junction between the Creffield Road and Mason's Green Road, Acton ; the floor is here about 6 feet from the surface, with a steeper slope to the river than the present surface ; it is covered to this extent with sand, brick earth, and trail deposits. At this site, on an area of about 40 feet square, were found nearly 600 unabraded worked flints, including long spear or javelin heads from 5 to 6 inches long, neatly trimmed to a point, and of the same form as those of obsidian, &c., now employed by the natives of New Caledonia, the Admiralty Islands, and Australia, for insertion into the shafts of their spears, to which they were fixed by lashings, &c. There were also shorter ones, not only wrought along the sides to the point where the flake required trimming, but also neatly chipped at the butts into rough rudimentary tangs. Such spear-heads have not only been described by Messrs. Lartet and Christy from the cave of Le Moustier, in the Dordogne, but have been met with in the alluvial deposits of the Somme at Abbeville, the Seine, and other French rivers, as well as by Dr. J. Evans, from Mildenhall, &c. Roughly wrought hatchets, axes, or choppers formed from flakes chipped on one or both faces to a cutting edge were also found rather abundantly on the floor. They are probably some of the earliest rude celt forms, and have been found also in other gravel deposits of the district. At the Creffield Road site they were discovered both finished and unfinished, and correspond with similar tools described by Dr. Evans from the high-level deposits at High Lodge, Mildenhall, Santon Downham, and Fisherton, near Salisbury, &c., as well as in the high-level Quaternary drift at Sauvigny (Loire) described by Dr. H. Jacquinot, and in the deposits of Le Moustier (Dordogne), &c. Some of the specimens exhibited were worked on both faces and pointed, thus approaching the Saint Acheul types, which M. G. de Mortillet considers as belonging to the earliest drift series, that of the Chelléen epoch ; they have also been described from other places in North-West Middlesex, as well as by Prof. Boyd-Dawkins from Wookey Hole, and by Dr. Evans from Biddenham, Bedford, Thetford, &c. Among the most interesting implements exhibited were borers, awls, or drills, some being large enough for boring wood ; while others were sufficiently small for piercing bone needles, and also flints with neatly chipped symmetrical depressions, which it is believed were used as shaft-smoothers, or spokeshaves, like those lately exhibited in Mr. Dunn's collection of Bushman and Hottentot stone implements at the Colonial and Indian Exhibition. Large numbers of knives formed from flakes, often neatly worked on the edge with fine secondary work, and also saws chipped with a distinctly serrated edge, were exhibited from this site, with other tools apparently intended to be used as chisels, &c. Large numbers of waste flakes, as well as blocks of flint which had been worked upon, were also found at this spot ; and in Ealing, about two miles distant, in a deposit of about the same age, a large boulder of metamorphic rock, concave on both faces and roughened and scored in the hollows from use, was met with ; it is 7½ inches long : and a quartzite boulder which fits the hollows was found near it, in fine gravel. They are the first pounding-stones discovered in the drift deposits. The author—after describing the various typical forms of the flint implements from the river-drift deposits of Ealing, Acton, Hanwell, Dawley, &c., in his large collection, and their respective ages, as educed from the position or level at which they have been found, as well as their condition,

whether abraded or unrolled, with other surface features of the specimens—showed that the flint implements from the Thames Valley may be divided into three groups, decreasing in age from the highest beds of drift to those lower in the valley as the process of erosion and part infilling of the valley continued. The implements and flakes found at the Creffield Road working site, which are as sharp and unabraded as on the day they were struck from the cores, were compared both as to their forms and associated Quaternary fauna with those from the upper drift of England and France. When considered in reference to M. G. de Mortillet's classification of four divisions—*i.e.* the Chelléen or Acheuléen, with which remains of the older Quaternary fauna, such as *E. antiquus*, *Rhinoceros hemitœchus*, hippopotamus, large cave-bear, &c., are associated; the Moustierien characterised by lance-heads, chopping-tools, &c., formed, from flakes, with the later Quaternary fauna, such as the *E. primigenius*, *Rhinoceros tichorhinus*, reindeer, &c.; and the less ancient divisions of the Solutréen and Magdalénien—Mr. Allen Brown showed, from the discovery of *Rhinoceros hemitœchus*, of hippopotamus, and an older form of deer, &c. (though at the mid-terrace stage of the erosion of the valley), by Colonel Lane-Fox and others, that the fabricators of the human relics discovered at the workshop site at Creffield Road lived contemporaneously with some of the older Quaternary fauna, and that they may therefore be considered as older than the epoch Moustierien, and may perhaps belong to the Chelléen period; but it is evident most of them were intended for mounting in handles or shafts, as such implements are hafted now by Australians and others, and not as "the *coups de poings*," or fist-strikers, of M. de Mortillet; and that, since they were made, the vast mass of matter represented now by the space between the 100-foot contour and the present bed of the Thames, two miles away, has been eroded. A large collection of objects from the workshop floor were exhibited, and many other flint implements from North-West Middlesex, illustrating the author's classification.

Geological Society, December 1.—Prof. J. W. Judd, F.R.S., President, in the chair.—Henry Howe Arnold-Bemrose, Richard Assheton, Francis Arthur Bather, Rev. Joseph Campbell, John Wesley Carr, Thomas J. G. Fleming, Thomas Forster, Edmund Johnstone Garwood, George Samuel Griffiths, Dr. Frederick Henry Hatch, Robert Tuthill Litton, Frederick William Martin, Richard D. Oldham, Forbes Rickard, Albert Charles Seward, Herbert William Vinter, and Charles D. Walcott were elected Fellows of the Society.—The President announced that he had received from Prof. Ulrich, of Dunedin, New Zealand, the announcement of a very interesting discovery which he had recently made. In the interior of the South Island of New Zealand there exists a range of mountains, composed of olivine-enstatite rocks, in places converted into serpentine. The sand of the rivers flowing from these rocks contains metallic particles, which, on analysis, prove to be an alloy of nickel and iron in the proportion of two atoms of the former metal to one of the latter. Similar particles have also been detected in the serpentines. This alloy, though new as a native terrestrial product, is identical with the substance of the Octibeha meteorite, which has been called octibehite. Prof. Ulrich has announced his intention of communicating to the Society a paper dealing with the details of this interesting discovery—which is certainly one of the most interesting that has been made since the recognition of the terrestrial origin of the Ovifak irons.—The following communications were read:—On a new genus of Madreporaria—*Glyphastræa*, with remarks on the *Glyphastræa forbesi*, Edw. and H., sp., from the Tertiaries of Maryland, U.S., by Prof. P. Martin Duncan, M.B., F.R.S.—On the metamorphic rocks of the Malvern Hills, part 1, by Frank Rutley, F.G.S., Lecturer on Mineralogy in the Royal School of Mines. Part 1 is the result of conclusions arrived at in the field; part 2 will be devoted to a microscopic description of the rocks. The author referred especially to the paper by the late Dr. Holl, whose work he, in the main, confirmed. Dr. Holl's object was to demonstrate that the rocks which had hitherto been treated as syenite, and supposed to form the axis of the hills, were in reality of metamorphic origin, and belonged to the pre-Cambrian. Mr. Rutley restricted his observations to the old ridge of gneissic syenite, granite, &c., which constitutes the main portion of the range, and, reversing the order of his predecessor, commenced at the north end of the chain. He considers that the beds of crystalline rock, mostly of a gneissic character, in the old ridge have been disposed in a synclinal flexure, which stretched from the north end of the chain to the middle of Swinyard's Hill, where they receive an anticlinal flexure, and are faulted out of sight. The length of this synclinal fold would be over 5½ miles. The lithological evidence is in favour of the rocks forming the north part of Swinyard's Hill being a repetition of those on the Worcestershire Beacon. We might expect to find the older beds having the coarsest granulation, and being even devoid of foliation, and this is what occurs on the Malverns, where the northern hills are made up of the coarsest rocks, with finer schistose beds towards the south; the exception is at Swinyard's Hill; hence there are two groups of coarsely crystalline rocks at either extremity of the presumed synclinal. The contrast between these and the fine-grained rocks of the other portions of the range has already attracted attention. The most northern of the coarse-grained masses is cut off towards the south by a fault near the Wych, while the other lies between a fault on the north side of the Herefordshire Beacon and the before-mentioned fault on Swinyard's Hill. The metamorphic rocks of the Malverns seem, therefore, to be divisible into three series, extending from the North Hill to Key's End; a Lower, of coarsely crystalline gneissic rocks, granite, syenite, &c.; a Middle, of gneissic, granitic, and syenitic rocks of medium and fine texture; and an Upper, of mica-schist, finely crystalline gneiss, &c. A diagrammatic section shows the distribution of these: the northern block, extending as far as the Wych, consists of the Lower and the lower part of the Middle; the central block, from the Wych to the fault in Swinyard's Hill, consists chiefly of the Lower and upper Middle, but with a portion of the Lower at the south end; the southern block, south of the fault on Swinyard's Hill, consists wholly of the Upper series. How far the foliation of these rocks and their main divisional planes represent original stratification must, the author thought, remain an open question. It has been held that the strike of foliation lies parallel to the axes of elevation; but this is far from being the case in the Malverns. Still a once uniform strike may have been dislocated by repeated faulting. The author further discussed the general question of how far foliation may or may not coincide with planes of sedimentation. He admitted that the absolute conversion of one rock into another by a process of shearing has been shown to occur, but doubted its application in this case. Although he is inclined to believe that the divisional planes, with which the foliation appears to be parallel, may be planes of original stratification, yet, as a matter of fact, they are nothing more than *structural planes of some sort*, between which the rocks exhibit divers lithological characters.—On fossil chilostomatous Bryozoa from New Zealand, by Arthur Wm. Waters, F.G.S. The fossil Bryozoa described in the present paper are from the localities of Petane, Waipukurau, Wanganui, and some simply designated as from the neighbourhood of Napier. The first three represent deposits of a well-known position, which was considered Miocene by Tenison-Woods, but which Prof. Hutton (*Quart. Journ. Geol. Soc.*, vol. xli.) has more recently called Pliocene. Some others, sent over as from "Whakati," are thought to be from Waikato. The genus *Membranipora*, which is largely represented from near Napier, is not one of the most useful palæontologically, because the shape of the opesial opening only, and not the oral, is preserved, and also the appearance of the zoœcia is often remarkably modified by the ovicells, which, however, are frequently wanting, and in many well-known species have never been found. The author pointed out that in the commoner and best-known species of Bryozoa the amount of variation is recognised as being very great, and considered that in the face of this there is too great a tendency to make new species on slight differences which may be local variations, and that even in some cases, instead of the description referring to a species, it may be that only a specimen has been described. A list of New Zealand Bryozoa has been drawn up by Prof. Hutton, and our knowledge of the New Zealand and Australian Bryozoa is being constantly increased by MacGillivray, Hincks, and others; nevertheless, enough is not yet known to fix the exact age by means of the Bryozoa alone, but the large number of species entirely identical with those living in the neighbouring seas, and the general character of the others, show that the deposits must certainly be considered as of comparatively recent date. Out of the seventy-eight species or varieties, sixty-one are known living, twenty-nine of these from New Zealand seas, forty-eight from either New Zealand or Australian waters, and twenty-eight have been found fossil in Australia. Judging from these alone, it would

seem that some authors have assigned too remote an age to the deposits. The new forms described were:—*Membranipora occultata*; *Monoporella capensis*, var. *dentata*, *M. waipukurensis*; *Micropora variperforata*; *Mucronella tricuspis*, vars. *waipukurensis* and *minima*, *M. firmata*; *Porina grandipora*; *Lepralia semiluna*, var. *simplex*, *L. bistata*; *Schizoporella cinctipora*, var. *personata*, *S. tuberosa*, var. *angustata*; *Cellepora decepta*, *Cellepora* sp.

Royal Microscopical Society, November 10.—Rev. Dr. Dallinger, F.R.S., President, in the chair.—A microscope, with case of apparatus and a cabinet of objects, bequeathed to the Society by the late Miss Tucker, was laid on the table.—Amongst the exhibits was a microscope for examining minute aquatic organisms under very high pressures; Leeuwenhoek's microscopes; objectives made of the new glass by Zeiss and by Powell, which were very highly spoken of by the President and others; and some gold-plated diatoms.—Mr. S. O. Ridley read a paper on the classification and spiculation of the monaxonid sponges of the *Challenger* Expedition; drawings and specimens illustrative of the various typical forms were shown.—Mr. A. Dendy also read a paper on the anatomy and histology of the monaxonid sponges of the *Challenger* Expedition, the subject being illustrated by drawings and specimens.—Dr. Crookshank read a paper on flagellated Protozoa in the blood of diseased and apparently healthy animals. He described a disease known in India as "Surra," occurring among horses, mules, and camels. A parasite was discovered in the blood of these by Dr. Evans, and was referred to Dr. Lewis for an opinion as to its nature, who concluded that it was not identical with, but closely allied to, the flagellated organisms which he had observed in Indian rats. Five years later an outbreak of the same disease occurred in British Burmah, and the report of an investigation was published by Veterinary Surgeon Steel, who observed the same parasite, but regarded it as closely allied to the Spirillum of relapsing fever in man, and named it *Spirochæta evansi*. This opinion was not accepted by Dr. Evans, who placed blood, stained preparations, and material for section cutting, in Dr. Crookshank's hands for further opinion. Dr. Crookshank at once dispelled the idea of the parasite being a Spirillum, and gave a full account of his observations. These had led him to discover an anterior flagellum, a longitudinally-attached undulating membrane, and a posterior, acutely-pointed, rigid filament, from which characters he recognised that the parasite was a flagellated monad, probably absolutely identical with the parasite discovered by Mitrophanow in the blood of the carp, and named by him *Hæmatomonas carassii*. Dr. Crookshank consequently observed that the Surra parasite should rather be called *Hæmatomonas evansi* than *Spirochæta* as suggested by Steel. Lewis's observation with regard to the flagellated organisms in Indian rats led Dr. Crookshank to investigate the species obtainable in England, which resulted in his discovering flagellate parasites in 25 per cent. of apparently healthy rats from the London sewers. These organisms proved to be morphologically identical with the Surra parasite and the parasite described by Mitrophanow in the blood of the carp, and were also recognised by a photo-micrograph made by Lewis to be identical with the organism observed by him in Indian rats, though Lewis's description and figures presented material differences.

Entomological Society, December 1.—Robert McLachlan, F.R.S., President, in the chair.—Messrs. W. H. Miskin, R.E. Salwey, and F. W. Biddle, M.A., were elected Fellows.—Mr. Howard Vaughan exhibited a long series of *Gnophos obscurata*, comprising specimens from various parts of Ireland, North Wales, Yorkshire, Berwick-on-Tweed, the New Forest, Folkestone, Lewes, and the Surrey Hills. The object of the exhibition was to show the variation of the species in connection with the geological formations of the various localities from which the specimens were obtained.—Dr. Sharp showed a series of drawings of New Zealand Coleoptera, by Freiherr von Schlereth, which, though executed in pencil, were remarkable for their delicacy and accuracy.—Mr. R. Adkin exhibited specimens of *Cidaria reticulata*, recently bred by Mr. H. Murray, of Carnforth, from larvæ collected near Windermere, on *Impatiens noli-me-tangere*. Mr. Adkin said that, as the food-plant was extremely local, Mr. Murray had endeavoured to get the larvæ to feed on some other species of balsam, including the large garden species usually known as Canadian balsam, but that he had not succeeded in doing so.—Mr. Billups exhibited a number of living specimens of *Aleurodes vaporariorum*, obtained from a greenhouse at Snaresbrook, where they had caused great havoc amongst tomato-plants (*Lycopersicum esculentum*). He remarked that the species had been first figured and described by Prof. Westwood in the *Gardener's Chronicle*, 1856.—Mr. Poulton exhibited the blood of a larva of *Smerinthus tiliæ*, and demonstrated, by means of a micro-spectroscope, the existence of chlorophyll therein.—Mr. G. T. Porritt exhibited forms of *Cidaria suffumata* from Huddersfield, and a series of small bilberry-fed *Hypsipetes elutata* from the Yorkshire moors, showing green, red-brown, and black forms.—Mr. S. Stevens exhibited forms of *Camptogramma bilineata* and *Emmelesia albulata* from the Shetland Isles, and a variety of *Chelonia caja* from Norwich.—Mr. H. Goss read a letter from the Administrator-General of British Guiana, on the subject of the urticating properties possessed by the larvæ and pupæ of certain species of Lepidoptera collected in Demerara.—Mr. McLachlan read a note concerning certain *Nemopteridæ*.—Miss E. A. Ormerod communicated a paper on the occurrence of the Hessian Fly (*Cecidomyia destructor*) in Great Britain. It appeared from this paper that there could be no longer any doubt as to the occurrence of the insect in this country, specimens obtained in Hertfordshire having been submitted to, and identified by, Prof. Westwood, and by Mr. W. Saunders, of Ontario. Prof. Westwood said the specimens agreed exactly with Austrian specimens in his possession, sent to him some years ago by M. Léfèvre, who had received them from the late Dr. Hammerschmidt, of Vienna. A discussion followed, in which the President, Mr. C. O. Waterhouse, Mr. Theodore Wood, and others took part.

Victoria (Philosophical) Institute, December 6.—A paper was read by the Rev. S. D. Peet on the religious beliefs and traditions of the aborigines of North America, which was followed by a discussion.

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Royal Society, December 6.—Mr. J. Murray, Ph.D., in the chair.—The chairman gave an opening address. Among other points, he referred to the almost total absence of recognition by Government of scientific research in Scotland. The Ben Nevis Observatory, for example, instead of receiving support from Government, is, on the contrary, a source of considerable revenue to it.—The Hon. Lord Maclaren communicated astronomical tables for facilitating the computation of differential refraction for latitudes 56° and 57° 30′.—Prof. Tait communicated the second part of his paper on the foundations of the kinetic theory of gases. In this part he treats of gaseous viscosity, and conduction and diffusion of heat in gases. In his investigations he takes account of the fact that the mean free path of swift-moving particles is greater than that of slow-moving particles. This point has been wrongly introduced by all previous investigators.—Mr. R. T. Omond communicated an account of a fog-bow observed on Ben Nevis, October 22, 1886. He communicated also an account of experiments on the temperature at different heights above ground at Ben Nevis Observatory. He hopes to repeat them under more favourable atmospheric conditions, and also when the ground is covered with snow.

Mathematical Society, December 10.—Mr. George Thom, President, in the chair.—Mr. R. E. Allardice read a paper on the equiangular and the equilateral polygon; and Mr. J. S. Mackay communicated a solution and discussion, by M. Paul Aubert, of a geometrical problem.

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Academy of Sciences, December 13.—M. Jurien de la Gravière, President, in the chair.—Glycose, glycogen, and glycogeny in connection with the production of heat and mechanical force in the animal economy, by M. A. Chauveau. In this third and last contribution on the subject, an attempt is made to determine absolutely the extent to which the combustion of glycose co-operates in the development of animal heat and energy. The part played by the liver in these phenomena is specially studied, and it is shown generally that the glycose supplied by the liver to the blood constitutes the principal aliment of organic combustions, whence are derived animal heat and muscular energy.—Note on an epidemic of typhoid fever which prevailed at Pierrefonds during last August and September, by M. P. Brouardel. This outbreak is clearly traced to the polluted sources whence was derived the water consumed by the inhabitants of the Pierrefonds district.—On the formation of Bilobites during the present epoch, by M. Ed. Bureau. In order to

determine the true character of the doubtful fossil organisms still by many naturalists classed with the Algæ, the author has carefully studied the traces of all kinds observed especially at points on the coast of Brittany, where extensive tracts are exposed at low water. Impressions have been taken of marks due to animals, yet exactly resembling the forms occurring in Secondary and even Primary formations often described and figured as belonging to the vegetable kingdom.—On the means of reducing momentary accelerations of velocity in machines fitted with regulating gear acting indirectly, by MM. A. Bérard and H. Léauté. The object of this memoir is to supply trustworthy governors, applicable especially to machinery used in the manufacture of gunpowder. For the apparatus here described, it is claimed that, while giving the required uniformity of action, it checks all abnormal increase of speed, so dangerous in this industry.—Observations of Finlay's comet (1886), made at the 0·38 m. equatorial of the Bordeaux Observatory, by M. F. Courty. The tabulated results of these observations include the mean position of the stars taken as points of comparison borrowed from Schœnfeld's Catalogue, published in the eighth volume of the "Bonn Observations," 1886.—A practical demonstration of the existence of diurnal nutation, by M. Folie. The remarkable agreement of the results here recorded, deduced from observations made at various points of latitude and longitude, is considered sufficient to prove the existence of the diurnal nutation of the terrestrial axis, and to determine its constant at about 0·2″.—On certain problems of isochronism, by M. G. Fouret.—On a theorem relating to the permanent movement and flow of fluids, by M. Hugoniot. The curious relation which is shown to exist between the permanent movement of fluids and that of the propagation of sound is here investigated.—On the coefficient of explosion for a perfect gas, by M. Félix Lucas. Various arguments are advanced to show that this coefficient is 1·40, not 1·41, the number generally adopted. — On the coefficient of pressure for thermometers, and on the compressibility of liquids, by M. Ch. Ed. Guillaume. The probable coefficient resulting from M. Descamps' experiments is shown to approximate very closely to that of Regnault, and the coefficients of compressibility must be corrected accordingly.—On the nature of electric actions in an insulating medium, by M. A. Vaschy. Assuming that the reciprocal actions of two electrified bodies are exercised through the intermediary of the intervening medium, and not directly at a distance, the author endeavours here to determine the part played by this medium in the transmission of the electrostatic actions. The medium itself is regarded as a combination of the ether and ponderable matter in relations to be subsequently determined.—Note on an absolute electro-dynamometer, by M. H. Pellat. By means of this instrument, which has been constructed by M. Carpentier, the intensity of a current may be determined directly in absolute value with an error less than 1/2000.—Note on steno-telegraphy, by M. G. A. Cassagnes. By this combination of mechanical stenography and telegraphy the operator is enabled to record and transmit along a single wire a considerable number of words instantaneously. Numerous experiments on the French lines have yielded the following results for a single wire: (1) 400 words a minute to a distance of 350 kilometres (with two finger-boards 24,000 words an hour); (2) 280 words a minute to a distance of 650 kilometres (with two boards 16,000 to 17,000 words an hour); (3) 200 words a minute to a distance of 900 kilometres (with one board 12,000 words an hour). Messages may even be forwarded simultaneously in both directions, and the system offers other advantages greatly accelerating and simplifying telegraphic work.—On a process of rock-erosion by the combined action of the sea and frost, by M. J. Thoulet. Certain results observed on the Newfoundland coast are attributed to the combined action of liquid and frozen water.—On some coloured reactions of arsenic, vanadic, molybdic, and arsenious acids, as well as of the oxides of antimony and bismuth, by M. Lucien Lévy.—Thermic phenomena accompanying the precipitation of the bi-metallic phosphates and allied salts, by M. A. Joly. Here are studied the extremely complex relations of bicalcic, bibarytic, distrontianic, and other phosphates, bibarytic arseniates, and monobarytic hypophosphate.—Heat of neutralisation of glyceric and camphoric acids, by MM. H. Gal and E. Werner.—On the water-bearing apparatus of *Calophyllum*, by M. J. Vesque. A study of this highly specialised apparatus enables the author to classify the twenty-five known species of the genus *Calophyllum*.—Analysis of the Javanese mineral waters, by M. Stanislas Meunier. The specimens here examined were brought from the Kuripan district, near Boghor, and yielded 54·203 per cent. of chloride of calcium, 40·651 of chloride of magnesium, 2·860 of chloride of sodium, 1·104 of chloride of potassium, and 1·924 residue insoluble in water.—On a new locality containing the nummulitic formations of Biarritz, by M. de Folin.—On the importance and duration of the Pliocene period studied in connection with the Roussillon basin; fresh documents relating to the Pliocene mammiferous fauna of this district, by M. Ch. Depéret. In the discussion which followed the reading of this paper, both M. Gaudry and M. Hébert argued that the Pikermi and Léberon deposits should be referred, not to the Pliocene, but to the Upper Miocene epoch.—Note on the reptiles and fishes found in the caves of Mentone, by M. Emile Rivière.—On the storm of December 8, by M. Fron.—The Föhn and its cosmic origin, by M. Ch. V. Zenger. It is argued that this wind is a cyclonic movement of cosmic origin, allied to such phenomena as the aurora borealis, electric and magnetic storms, terrestrial currents, and the seismic waves which so often accompany violent tempests.

BOOKS AND PAMPHLETS RECEIVED

Crustacea and Spiders: F. A. A. Skuse (Sonnenschein).—The Queen's Jubilee Atlas of the British Empire: J. F. Williams (Philip).—A Concise History of England and the English People: Rev. Sir G. W. Cox (Hughes).—The Tea-Planter's Manual: T. C. Owen (Ferguson, Colombo).—Disease and Sin (Wyman).—Hours with a 3-inch Telescope: Capt. W. Noble (Longmans).—Proceedings of the Davenport Academy of Natural Sciences, vol. iv. (Davenport, Iowa).—Zeitschrift für wissenschaftliche Zoologie, Vierundvierzigster Band, Drittes Heft (Engelmann, Leipzig).—Differential Calculus: J. Edwards (Macmillan).—Proceedings of the American Philosophical Society, vol. xxiii. No. 123 (Philadelphia).—Report of the National Academy of Sciences. 1885 (Washington).—Bulletin of the U.S. Geological Survey, Nos. 27, 28, 29 (Washington).—Morphologisches Jahrbuch, 12 Band, 3 Heft: Prof. Gegenbaur (Engelmann, Leipzig).—Bulletin de la Société Impériale des Naturalistes de Moscou, No. 2, 1886 (Moscou).

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